NOVEMBER 1958
—
JANUARY 1959
QUARTERLY
VOLUME II NUMBER 2
Price Rupee One

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Publication Office:
4, MOTILAL STREET, MADRAS-17
INDIAN INDUSTRIES is a Quarterly Publication, published in March, June, September and December.
Annual Subscription: Rs. 5 or £ 1 or 4 Dollars.

ENGINEERING NUMBER

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TASK AHEAD

Engineering industry plays a vital part in the industrial system of any modern country. It is the cornerstone of national economy. It opens new horizons of human life and freedom. It has to keep the pulse of technical research and progress ever agile and dynamic.

Our economic freedom is closely linked with the success of heavy and basic engineering industries which manufacture capital and producer goods. Phenomenal is the achievement of Engineering Industries.

The number of engineering factories have doubled during the decade 1946—1955 from 1053 in 1946 to 2,060 in 1955. Remarkable is the increase in the total productive capital from Rs. 23 crores to Rs. 85 crores. The average daily employment increased from 112,243 to 170,132. Nearly four times has shot up the value of annual output i. e. from Rs. 27 crores to Rs. 104 crores.

It is heartening to find that the growth of engineering industry is practically thrice as far as the growth of other sectors of our economy, namely, consumer goods, the agricultural production, the mineral development and the general non-engineering industries. The extent of progress made by the industry may be seen from the fact that the value of production by light electrical industries improved from Rs. 5 crores per annum to over Rs. 25 crores per annum in 1957, light mechanical industries from Rs. 2 crores to over Rs. 35 crores, heavy electrical industries from about Rs. 5 crores to about Rs. 29 crores, heavy engineering industries from Rs. 6 crores to Rs. 50 crores and machinery building industry from practically nil to Rs. 35 crores during the same period.

This is appreciable progress but our target for light electrical industries in 1960—61 is Rs. 40 crores. This gap of Rs. 15 crores is to be filled up. But the growing volume of demand may necessitate a rise in target by over 50%. We have to step up production.

Heavy electrical industries have made a spectacular progress. But we have to reach the target of Rs. 60 crores by 1961 *i.e.*, practically doubling up.

The Automobile Industry from meagre indigenous production of Rs. 6 crores in 1948 has touched the figure Rs. 50 crores in 1957. Within the next 2 or 3 years, all our manufacturing units will have 75 to 80% indigenous components.

The machine tools, starting from a scratch before a decade, the annual output is Rs. 3.5 crores. We will touch Rs. 10 crores in three years from now.

By 1961, 6 million tons of steel will be available in our country and by 1966 we have pledged ourselves to produce 15 million tons: (steel production in other countries: United states—100 million tons; U.S.S.R.—50 millions tons; U.K.—20 million tons; West Germany—20 million tons). We will be producing in plenty travelling cranes, wharf cranes, mobile cranes, underframes, heavy bridge sections and medium and heavy structurals.

With practically nil production of capital goods and machinery in 1948, we today produce textile machinery, jute machinery, sugar machinery, cement machinery etc., to the tune of Rs. 35 crores. But we import heavy machinery for Rs. 150 crores. This gap must be filled up.

Government has risen to the occasion by establishing a Central Heavy Machinery Building Plant with Russian Collaboration, costing about Rs. 100 crores; the Foundry Forge Plant with Czech collaboration at Ranchi; a Heavy Mining Equipment Plant at Durgapur with Russian aid; a Heavy Plate and Vessel Works and a Heavy Structurals Shop with British collaboration; a Heavy Machine Tool Plant with German aid; the Heavy Electrical Equipment Plant at Bhopal with the collaboration of the renowned A. E. I. of U. K.

Thus by 1961 we will have a strong foundation for the vast production of heavy machiney and capital goods and we will produce engineering goods to the tune of over Rs. 300 crores a year.

Not only are we rich in bauxite, but also in copper ores, lead ores and zinc ores. We will require Rs. 45 crores worth of non-ferrous metals by 1961 but our indigenous production at present is only Rs. 7 crores. We need annually about 40,000 tons of aluminium, 45,000 tons of copper, 50,000 tons of zinc and 20,000 tons of lead by 1961. We are rich in high grade bauxite and our aluminium prodution will reach 40,000 tons a year within three years. We need not despair over the gaps in copper, zinc and lead as by that time we will set up smelting, refining and metals-producing capacities, particularly at the port towns. If we stumble over the discoveries of these rare metals providentially, we can switch over to indigenous production.

Export of engineering goods throws open new vistas. Our Trade Representatives abroad are ever agile to explore new avenues of trade contacts. A number of promotional measures as in the establishment of special Export Promotion Councils, conclusion of bilateral trade agreements, sending of trade delegations, arranging exhibitions and fairs, opening and strengthening of Trade Commissioners' Offices abroad, increased commercial publicity are taken up by the Government.

Our cycles, sewing machines, electric fans, machine tools, electric motors, radios and other engineering products are first class in quality. They are in great demand in neighbouring foreign countries. With proper drive they are sure to earn more foreign exchange.

India's geopraphical situation, with ports looking across the seas towards friendly countries in the West and in the East makes it possible for our merchants to deliver their goods at competitive prices in these countries.

The accent on export of engineering goods will grow greater in future and our industrialists will rise to the occasion surely and gloriously.

Krishna Srinivas

Here is a masterly survey by an eminent specialist of the magnificent future that awaits heavy industries.

HEAVY ENGINEERING INDUSTRIES

D. N. JALAN

President, Indian Chamber of Commerce, Calcutta

The role of heavy engineering and machine-building industries, in providing the foundation for rapid economic development, has been recognised in the high priority given to these industries in the Second Five-Year Plan. Despite the foreign exchange shortage which necessitated a reduction in the total outlay on the Plan from Rs. 4,800 crores to Rs. 4,500 crores, the allocation, for industries and minerals, according to the "Appraisal and Prospects" of the Plan, was raised from Rs. 690 crores to Rs. 790 crores and, according to the second appraisal, this sum was further increased by Rs. 90 crores to Rs. 880 crores.

Together with the efforts to achieve the target of 6 million tons of steel by 1961 with, perhaps, a further increase of 9 million tons, to a total output of 15 million tons by the end of the Third Five-Year Plan, the programme of production, planned for the machine-making industries, is an index of the nation's determination to meet as large as possible a proportion of the requirements of capital goods and machinery, from domestic sources.

The rate of progress attained by the various units engaged in the manufacture of machinery may be considered encouraging. Starting almost from scratch in 1950, the value of machinery produced, at present, is estimated at Rs. 36 crores a year. In 1957, manufacture of jute mill machinery amounted to Rs. 106.27 lakhs in 1957, as against Rs. 29.56 lakhs in

1956. Sugar mill machinery increased from Rs. 32.06 lakhs in 1956 to Rs. 162.06 lakhs in 1957: oil mill machinery from Rs. 11.42 lakhs in 1956 to Rs. 26.56 lakhs in 1957. In spite of this remarkable rate of expansion, the total production of machinery in 1957 was only about one-fifth of the amount of machinery imported in that year. There is, thus, a big gap that remains to be filled.

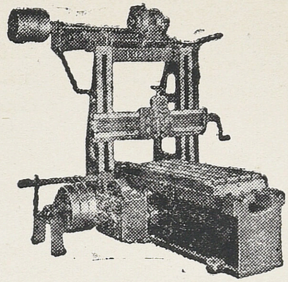
Production of textile machinery has been making good progress. Output of ringframes increased from 1,116 in 1956 to 1,366 in 1957 and of carding engines from 732 in 1956 to 1,020 in 1957. Production of plain looms, however, remained the same as in 1956, at 2,668.

Of the units engaged in the manufacture of textile machinery, Textile Machinery Corporation and National Machinery Manufacturers are prominent. Texmaco are the pioneers in India of the manufacture of cotton ring spinning frames. Regular production of these frames for cotton and staple fibre started in 1950. Later, with the technical collaboration of S. K. F. Ball Bearing Co. Ltd., the Corporation started the manufacture of bearings. Texmaco claims to be the best equipped factory in the country for production of various textile machinery items. In collaboration with Howa Machinery Ltd, of Japan, they have progressed in the production of Drawing and Speed Frames. They hope to manufacture all the components of carding engines by the end of 1958 and plan to manufacture 300 such engines a year.

National Machinery Manufacturers have been carrying on regular production of Spinning Frames, Ring Spinning Spindles, Fluted Rollers, Top Rollers, Plain Cast Iron Inner Tubes, etc., since 1949. Production of complete Ring Frames started in 1954. Plans are under way to expand its capacity for Carding Engines to 600 a year.

Other units engaged in manufacture of textile machinery are Textools Ltd. of Coimbatore, Star Textile Engineering Works, Acme Manufacturing Co. and others. These firms manufacture Fly Frames, Draw Frames, Ring Spinning Frames. etc. They too, in most cases, have expansion programmes, on completion of which, total production of textile machinery, on double shift basis, is expected to be about 1,700 carding engines, about 1,900 ring frames, 170 fly frames, 84 drawing frames and about 5,000 looms (plain, semi-automatic and automatic).

The value of jute mill machinery produced in 1957 is estimated at Rs. 106.27 lakhs. Three firms, Textile Machinery Corporation, Britannia Engineering Works and Logan Jute Machinery Company, in collaboration with three foreign concerns, Fairbairn Lawson Combe Barbour of Leeds, James F. Low and Co. of Scotland and James Mackie and Sons, plan to manufacture



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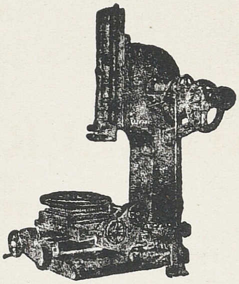


24,000 spindles and 120 spinning frames per year.

Appreciable progress has been made in schemes for manufacture of sugar mill machinery. Several agreements have been entered into by Indian manufacturers with foreign concerns for collaboration in the manufacture of sugar mill machinery in India. Walchand Industries have sought technical collaboration with Skoda Works of Czechoslovakia for production of three complete sugar mills. Protos Engineering Works of Bombay, with the help of Buckan Wolf of Germany, intend to produce two mills per year. Indian Sugar and General Engineering Corporation, in collaboration with a Scottish firm, have a programme for manufacturing the requirements of another two mills a year. Textile Machinery Corporation, which have hitherto been manufacturing such items as evaporators, vacuum pans, crystallisers, etc., have now taken up the manufacture of complete plants, in collaboration with Storks Warspoor of Holland.

Besides these, there are other concerns, such as Richardson and Cruddas., Arthur Butler & Co., Saran Engineering Works, etc., which are manufacturing items of sugar mill machinery. On the basis of the progress made by various units in their plans for manufacture, the Planning Commission, in its appraisal, expected that the target capacity for sugar mill machinery, fixed at Rs. 2.5 crores under the Second Plan would be achieved.

Only limited progress has been achieved in the manufacture of cement machinery. The value of such machinery produced in 1957 is estimated at Rs. 62 lakhs, against Rs. 42 lakhs in 1956. Associated Cement Companies Limited, in collaboration with Fuller & Co., of the U.S.A., were permitted, in 1955, to manufacture Clinker Coolers. The scheme aims at manufacture of four cement plants, of 500 tons daily capacity, of the value of Rs. 2 crores each, to meet the replacement needs, which may be expected to arise from the end of the Second Plan onwards.

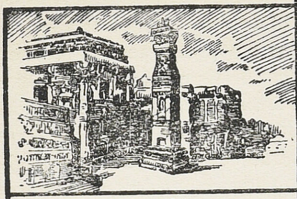
Fairly good progress has been made in the manufacture of Vegetable Ghee Plants. There are four concerns in South India, which are engaged in this line and have supplied complete plants to a number of vanaspati factories.

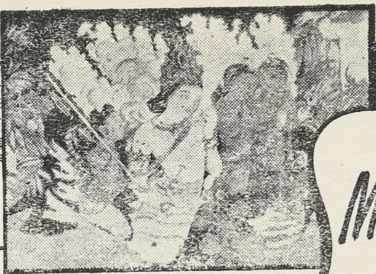
It is in the fitness of things, that the steel manufacturing plant itself should be produced in India.

For this purpose, the Government of India have completed arrangements for establishment of a central Heavy Machinery Building Plant with Russian collaboration. This plant is expected to cost Rs. 80 crores in the first stage and Rs. 160 crores in the second stage. When completed, it will produce a complete steel plant, every two years. In order to feed this plant a contract was signed, on August 18 last, between India and Czechoslovakia for a Foundry Forge Project at Hatia near Ranchi, in Bihar. This project is expected to start porduction by the middle of 1962. During the first stage, the annual production capacity of the factory will be 2,500 of grey iron castings and 140,000 tons of steel castings, of a maximum weight of 17 tons per piece. There is also provision for a 2,600 tons press to be installed in the first stage, which will raise the capacity for manufacture of forgings to 18,500 tons.

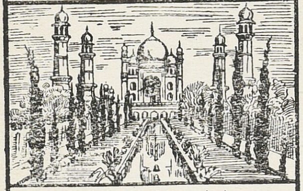
These two units, in combination will produce the heavy machinery and the steel equipment required by the chemical, engineering and other industries.

Work for setting up of the Heavy Electrical Equipment Plant at Bhopal has already started, in collaboration with Associated Electrical Industries of the U.K. This plant is expected to cost Rs. 21 crores during the Second Plan period. The execution will be completed by 1960, when the production of transformers, switchgears, central gears and capacitors will begin. In the second phase, the plant will produce hydraulic turbines and generators, heavy electric motors, crane motors, generators for Diesel sets, welding transformers, heavy rectifiers, etc. When complete, the

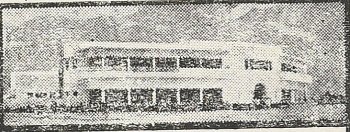

The Kailasa temple, Eliora.


One of the many frescoes of Ajanta.

MONUMENTS of a magnificent past!


Bibi-Ka-Maqbara, Aurangabad.

The famous frescoes of AJANTA and stupendous rock temples of ELLORA exhibit an admirable combination of architecture, sculpture and painting. These monuments are within easy reach from Aurangabad.



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plant will be producing on a two shift basis, a turnover of about Rs. 25 crores a year.

Steps have also been taken to meet the requirements of paper, mining and other industries. A plant with a capacity of 30,000 tons of mining equipment is being established at Durgapur. A Heavy Plate and Vessels Works and a Heavy Structural Shop, to be established with British collaboration, are in process of negotiation. The scope for setting up of a plant for manufacture of paper making machinery in India is being explored by an American Company, Baloit Iron Works, in collaboration with Indian capital. A Bombay firm is attempting the manufacture of knitting machines, in co-operation with a Japanese concern. The Government of India have entered into an agreement with another Japanese firm, Komatsu Manufacturing Company, to manufacture earth-moving machinery in India.

Closely related to machine-making is the machine tool industry. Striking progress has been made in this field in the last two years. The total value of machine tools production in 1957 is estimated at Rs. 250.84 lakhs, against a meagre Rs. 2.21 lakhs in 1950. Hindusthan Machine Tools registered a 300 per cent increase in production over its performance in the previous year.

Other big units producing machine tools are Cooper Engineering Ltd., Investa Machine Tools and Engineering Co., Ltd., The Machine Tools Prototype Factory, Mysore Kirloskar Ltd., Praga Tools Corporation etc. Textile Machinery Corporation intend to start manufacture of machine tools, in collaboration with a leading British firm. The Government Precision Instrument Factory at Lucknow is progressing well. Its annual production of Water Meters in 1955—56, reached about 13,500 against

only 424 in 1951—52. The factory is also making Bar Automatics, Magazine-loaded Gear Hobbling Machines, Production and Precision Tool Room Lathes, including capstan and turret and repetition lathes, circular and surface grinders, etc. Besides these large units, there are about 150 small factories located mostly at Batala in Punjab.

All this adds up to a remarkable record of progress in the sphere of machine-making accomplished in a brief span of time.

It seems that, by the end of 1961, when demand is expected to amount to about Rs. 300 crores machine-making industries may find it difficult to reach an output of even Rs. 100 crores. The gap of at least Rs. 200 crores, between requirements and domestic supply, will put a severe strain on the balance of payments. There is need for a determined drive to reduce this gap as much as possible. To begin with, efforts could be made to bring the existing idle capacity into use.

The principal problem which the engineering industries, as a whole, face at present is shortage of raw materials particularly steel. Imports of steel declined from 1.73 million tons in 1956 to 1.62 million tions in 1957. In the first six months of 1958, the figure was 6,35,702 tons. However, with the implementation of the various schemes to produce steel in the country, this problem is expected to be solved in the near future. Another difficulty which these industries have to contend with is the shortage of imported components and parts as a result of foreign exchange situation. In view of the increased volume of foreign aid, which has been made available recently it would perhaps be possible to relax, to some extent, the rigidity of import restrictions on such items as are essential for the efficient functioning of these industries.

* * *

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MACHINE TOOLS

P. M. RAJE

Public Relations Officer, Hindustan Machine Tools (P) Ltd., Bangalore

In the present age of rapid scientific and technical development, Machine Tools are the most indispensable pre-requisites to all forms of production. For our growing industries, we need plant and machinery and this plant and machinery can be produced only if we have a virile Machine Tool Industry. The term 'Machine Tool' is a generic term which indicates machines that are designed to produce other Machines and which can popularly be described as 'Parent Machines'. Machine Tools include from small lathes and drills to huge planers, Vertical Boring Mills, Plano Millers, etc., weighing hundreds of tons.

In the context of India's present economic structure, the Machine Tool Industry assumes very great importance because unless the manufacture of Machine Tools is accelerated, we can never hope to implement our industrial plans. This can be sufficiently testified from the fact that hitherto all modern large-scale factories were erected in this country with the help of foreign plant and machinery. This dependence on imported machines for setting up new industries greatly retards our industrial development and further drags the country into the vicious circle of 'foreign exchange shortage'. Thus, if India has to develop faster and on its own, the Machine Tool Industry is a 'MUST'.

Progress in other Countries

A comparative study about the state of Industry elsewhere reveals that India, at the moment, is far behind other countries. With

its long tradition and achievement in this field, Britain is rightly regarded as the cradle of the Machine Tool Industry. U.S.A., Germany and France too have done commendable progress in regard to this industry. It is said that in France the Machine Tool has been the basic instrument in reducing the labour week from 70 hours in 1850 to 60 hours in 1899 and to only 40 hours in 1958. These tools have also made possible a substantial reduction in time for manufacturing French Automobile from 5,000 hours in 1910 to 250 hours now. Switzerland enjoys the reputation for 'precision' in this field. It was in Switzerland that the first European six spindle automatic lathe of the vertical type and the first electronic single spindle turret automatic lathe with a remote control mechanism were developed. Viewed against this background, Indian Machine Tools can be said to be in a stage of infancy. Nevertheless, it can now be asserted that the foundations for a growing Machine Tool Industry have been laid in this country.

War Time Boom

Although India has been producing Machine Tools since 1890, well till 1941, no attempt was made to organise the industry in a planned manner. A few items, simple to produce, and not involving much of complicated processes were produced by indigenous industries principally for their own use. It was in 1941 that a very critical situation arising out of World War II forced the then Government to give some thought in regard to this industry. The main consideration was, of course, to gear the industry to war time needs. While imports of specialised Machine Tools needed for our essential services, like the Railways and Ordnance Factories became increasingly difficult to obtain on account of war situation abroad, demand for machine Tools in the country increased phenomenally and hence the Indian industry had to be geared to the manufacture of these defence equipments. Thus the industry sprang up and developed at great speed under war time pressure and the total number of graded machine tools manufactured in India which was only 273 in 1942 rose to 8,810 valued at about Rs. 1.75 crores in 1946.

The cessation of hostilities, however, dealt a severe blow to this industry and the industry which could more or less be described as a 'war time baby' faced the proverbial fate of any other industry with an identical growth. Then came the Partition with which some six graded and about 50 ungraded Machine Tool manufacturers were completely cut off. Post-Independence India thus inherited an industry which was on its last legs.

Initiative by Government

With the advent of planning, it was soon realised that the Machine Tool Industry was the very foundation for industrial development of the country and, therefore, a 'MUST' and the Government had to think in terms of giving an effective fillip to the planned growth of this industry. The initial difficulty, however, was that private capital was not forthcoming for the simple reason that this Industry while involving large capital investment did not hold out prospects for large and quick returns.

Subsequently, the Government of India stepped in. They entered into a technical collaboration agreement with the well-known firm Messrs Oerlikon Machine Tool Works, Buehrle & Co., Zurich, and a plant to produce Medium/Heavy Machine Tools in the country was soon set up in Bangalore. The Hindustan Machine Tools Project thus came into being in the latter half of 1949. The period between 1949 and 1953 was mainly devoted to preliminary work and the factory commenced production late in 1955. The first series of lathes manufactured in the factory came off its production lines in May 1956.

Integrated Production Programme

In the initial stages of the establishment of the Hindustan Machine Tools, there were certain misunderstandings between the Machine Tool Units in the Private Sector and

the Public Sector. This gave rise to differences of opinion and overlapping in regard to production. The Government of India rectified this anomaly by the appointment of the Machine Tool Committee in early 1956. Public and Private Sector industries and consumer interests were represented on this Committee. The Committee attempted to estimate the demand for different categories of Machine Tools during the Second Plan period and also assessed the capacity of these industries and thereafter proceeded to recommend an integrated plan of development for the Second Plan period. These recommendations were made with a view to avoiding overlapping and consequent wastage of productive effort, and giving a fillip to the production activities of all units enabling them to contribute to the growth of the industry as a whole. Under the scheme, recommended by this Machine Tool Committee, the principal categories of Machine Tools have been allotted to the following different units existing in the country.

Firm	Item of Manufacture
M/s. Cooper Engineering Ltd.	Geared shapers upto & including 32" stroke (Gradual changeover from cone-pulley to geared head) Planners upto and including 6' x 6' x 16"
	Slotters, upto & including 21" stroke.
M/s. Hindustan Machine Tools (Private) Ltd.	Lathes 17" Swing, present & allied models
	Milling Machines (No. 2 & No. 3) Plain, Vertical, Universal and Manufacturing (heavy type)
	Grinding Machines O.D., Universal & I.D.
	Radial Drilling Machines
	Lathes 20" to 28" Swing
	Production Jig Borers
	Lathe (other types) Capstans & Turrets
M/s. Investa Machine Tools & Eng. Co. Ltd.	Drilling Machines, Pillar 1¼" to 2"
	Drilling Machines Column upto 3"
	Drilling Machines, Radial below 2"
M/s. Machine Tool Prototype Factory.	Lathes, Geared head 10" Swing
	Lathes Capstan ½"
	Grinders, Surface 18" x 24" Swing
	Grinders, Tool & Cutter
	Lathes, Capstan 1¼"
Mysore Kirloskar Ltd.	Lathes 12" to 28" Swing
	Lathes—Capstan 1½"
	Lathes—Capstan 2½"
	Lathes—Turret 3½"
M/s. Praga Tools Corporation Ltd.	Drilling Machines Bench
	Drilling Machines Pillar 1" & 1½"
	Milling Machines No. 1
	Lathes, Bench.

Role of H.M.T.

The Hindustan Machine Tools can now be said to have placed the manufacture of Machine Tools in this country on a firm pedestal. Production in this factory has been gradually stepup from 25 machines per month in January 1957 to 36 per month by May 1957 and 42 by November 1957. Production now exceeds 50 machines per month. Although originally planned to work on a single shift basis and to reach a production of 400 machines per annum by 1960—61, the factory revised its original plan in view of the vast increase in the demand for machine tools and commenced introduction of multiple shift working from about September 1956. Production has been more then doubled and in the financial year 1957—58, the factory exceeded the original target set for itself for 1960—61, three years ahead of scheduled. According to the original plan, the factory was to reach a production rate of 400 machines per year by 1960—61 whereas it has not only exceeded its rate of production but also diversified its production. The factory is currently

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producing high speed precision lathes in two sizes and a range of Milling Machines—Vertical, Horizontal and Universal in 2 sizes each.

In the light of the country's demand, the factory's production programme has been further diversified to include the manufacture of "Radial Drills". A technical collaboration agreement with M/s. Hermann & Kolb of West Germany has been signed recently and the factory will soon start the production of 10 types of Radial Drills in 1½" and 2" sizes. The first HINDUSTAN Radial Drill is expected to be in the market in December this year.

The addition of these Radial Drills to the existing range of 8 Machine Tools is expected to give further flexibility to the production programme of the factory. This will also result in annual saving of about Rs. 1 crore of foreign exchange on these machines which had been hitherto imported.

It is very significant to note that during the financial year 1957—58, Hindustan Machine Tools produced 66% of the Machine Tools. Against an overall production amounting to about Rs. 2.4 crores in the country, HMT's production amounted to Rs. 1.66 crores during this period.

Big Gap

The country has yet to make greater efforts in achieving self-sufficiency in regard to its needs for Machine Tools. The imports of Machine Tools have been rising steadily since 1950 and with the implementation of our First Five Year Plan, the rise has been very phenomenal. The value of Machine Tools imports has increased from Rs. 2.5 crores in 1950 to Rs. 8.37 crores in 1956. In 1957, these imports are estimated to have been in the vicinity of Rs. 10 crores. Against these imports our production has risen from Rs. 28.59 lakhs in 1950 to Rs. 2.1 crores in 1957 (calendar year). The same as pointed out earlier, amounted to Rs. 2.4 crores during the financial year 1957—58.

The rise in production has been mainly due to the increasing tempo in production in the State-owned Factory in Bangalore. Our demand for Machine Tools will be further rising and in the background of the increase in consumption of steel anticipated by the end of the Second Five Year Plan, it is estimated that India would need Machine Tools worth Rs. 15 to 17 crores per year. Unless a substantial portion of this requirement is produced indigenously, the country will have to depend upon foreign market. This will not only cause a terrible drain on our limited foreign exchange but will also lead us to the vicious circle of depending for our development programme on foreign sources.

It is gratifying to note that plans are well in hand for the expansion of several other Units notably Mysore Kirloskars, Praga Tools and the Prototype of Ambernath. If these plans materialise and are not impeded by foreign exchange and other difficulties the H.M.T., Mysore Kirloskars and other Machine Tool producers in India will be able to meet a substantial portion of the rising demand for Machine Tools in the country and will enable India to be self-sufficient by the Second Plan in regard to the most basic categories of Machine Tools like lathes, Milling Machines and Radial Drills.

Once the basic Machine Tool Industry is well established in the country, it will be one more step before we establish our Machine Building industry to manufacture the plant and machinery required for our numerous Civil and Defence factories of the future and thereby rid us permanently of our shortage of foreign exchange, foreign plant and machinery and free us from our dependence on foreign aid and thus achieve the much needed economic independence.

* * *

Saving foreign exchange nearly Rs. 10 crores a year, this light engineering industry will reach greater heights in future. Shri Iyer's study is superb and illuminating.

CYCLE INDUSTRY

N. K. IYER

T. I. Cycles of India Ltd., Madras

Among the post-Independence industries developed in India, the bicycle industry in the light engineering section, has made phenomenal progress. The reasons for this growth are encouragement from Government, good and efficient management by promoters, all-out technical assistance from foreign collaborators and the dexterity and quickness with which Indian labour has mastered the technicalities of machine production.

Although bicycle manufacture, as an industry in India first came into being in 1938, the progress was impeded during the war years and it was only in 1949 that the industry started to come into its own with the active assistance of the National Government of India and also the foreign collaboration that was more readily forthcoming.

In a comparatively poor country like India, the bicycle is eminently suited to the common man, as a means of transport. According to the 1951 census the population of India was 330 millions and now it is estimated that it has gone up to 380 millions. Bicycle ownership in India was two per thousand in pre-independence days and it rose up to 3.5 in 1949 and by last year it reached 11 per thousand, which is proof positive of its growing popularity. India still stands far behind, as compared to some other countries in the matter of usage, as in Sweden the number of cycles per thousand of population is 500, in Denmark 494 and even

in Ceylon it is 40 per thousand of population. These figures indicate the potentialities of the Indian bicycle industry.

The number of complete cycles imported in 1946—1947 was over 2,12,000 and it has tapered off, since the establishment of the industry in India and the gradual ban on imports, which is now absolute. The indigenous production starting with about 43,000 in 1947 has now reached almost 9,00,000 per annum. The cycle parts imported immediately after the cessation of hostilities, was in the region of Rs. 1½ crores per annum by the dealers and distributors. This is being maintained even now, but with the exception of essential parts like freewheels, chains, etc., the imports have been canalised over to the manufacturers and also small-scale assemblers.

The Government has laid it down more or less as a policy that the bigger manufacturers of cycle components should give priority in the matter of supply of such parts to small-scale manufacturers-cum-assemblers. As a consequence, with the restricted imports and inadequate quantity of supplies of indigenous parts, the prices of components in the replacements markets have tended to increase. It is hoped that the Government will soon realise the importance of supplies to the replacement markets through the established trade channels of dealer, distributor set-up and allow the stepping up of production of quality parts by those big manufacturers who are ready to do so. The manufacturers have at present their problem of not being able to cope with the full requirements of the consumers, as their production during the current year has been pegged at last year's level.

The per pack value of imported components allowed to the established large-scale manufacturers is less than Rs. 5 compared to Rs. 80 in 1952. The smaller manufacturers/assemblers are allowed Rs. 10 per pack value. This shows the increased tempo of manufacturing bicycle components in the country, during the short span of a decade.

The object of Government in restricting the import quotas is no doubt to foster the growth of indigenous manufacture of not only complete bicycles, but also cycle components and accessories, with a view to making India self-sufficient ultimately, without having to depend upon foreign sources of supplies. As against four manufacturing units licensed for the manufacture of bicycles in 1949—1950, there are now 26 units, carried on the approved list of the Development Wing of the Government of India. Besides these 26 manufacturers, there are 63 recognised small-scale bicycle factories and apart from these there are very many small-scale units unlisted numbering about 500, distributed all over India, primarily in the North.

The major manufacturing units are now in a position to manufacture almost all the components. Two of these, Sen-Raleigh Industries of India Limited and T. I. Cycles of India Limited have been functioning with the technical collaboration of British manufacturers, which has helped these firms to maintain high standards of quality and excellence of product. These major manufacturing units with foreign collaboration have also given considerable assistance to the Indian Standards Institute to set up standards for local manufacture of good and uniform bicycle components.

There is a clamour from small-scale manufacturing units that the major cycle producers must be compelled to obtain their requirements from these small-scalers, which is not altogether justified. First, the Government of India gave permission to the larger units to establish themselves, on the condition that all parts required for their bicycles will be manufactured by themselves. Secondly, the quality of bicycle parts manufactured by the small-scalers have not reached that stage of perfection, to ensure the confidence of the manufacturers of bicycles of well-known brands, to assemble them on their bicycles, as they naturally cannot afford to undertake the risk of undermining the reputation of their product by so doing.

In the interest, therefore, of the bicycle industry, the well-established larger manufacturing units should be allowed to work independently, catering to the markets they have themselves established. There is a huge replacement market estimated annually at about Rs. 3 crores, which is open to every one including the small-scalers. This figure is estimated on the assumption that there will be an absolute ban on imports of components and accessories by 1960—61, at the end of the Second Plan period.

All the raw materials necessary for the manufacture of bicycles are not yet produced in this country. Cold rolled steel strips, Bright hexagonal steel bars and free cutting steel have yet to be imported. The industry has also to depend on foreign sources of supplies, for consumable stores like nickel anodes and electro-plating chemicals of correct purity. Until recently, steel tubes for manufacture of frames had to be imported, but two units have come into production for this purpose, one at Jamshedpur under the name of Indian Tube Company Limited and the other at Avadi, near Madras, styled as Tube Products of India Limited. These two units are now supplying many of the steel tubes for the bicycle industry. The possibilities of meeting the entire tube requirements of bicycle industry and also other industries are being investigated and pursued by these two firms. With the establishment of the new steel plants under the aegis of the Government of India, the right type of steel might be produced and supplied to these units for the manufacture of all tubes, thus avoiding imports from foreign sources.

The total number of bicycles on the roads in India is now estimated at about four million and in 1960, the Tariff Commission is of the opinion that this figure is likely to go up to seven millions. The Development Wing of the Ministry of Commerce and Industry which originally estimated the annual demand for bicycles in 1960—1961 at 11 lakhs has recently revised the target to 15 lakhs and it is rumoured that they are thinking of raising it to 20 lakhs

The dawn of a bright future . . .

TO MILLIONS today, their only hope of securing better prospects in life lies in finding new channels of vocations. A cycle to them has become a symbol of their determination to seek a better livelihood. They stint and save to collect sufficient money to possess this miraculous machine which will open up new opportunities for them.

At T.I. Cycles we realise what a cycle means to its owner. And it is this knowledge that prompts us to build cycles that will last a lifetime. Although we produce two hundred thousand and more 'Hercules' cycles every year, the demand is far ahead of the supply. That shows the confidence people have in 'Hercules' cycles.

T. I. CYCLES OF INDIA LIMITED, MADRAS

Manufacturers of **Hercules** cycles

MUL 198653

per year. Considering that the output of the country for the current year will only be about nine lakhs, the estimate to be achieved within a period of two or three years is rather on the high side. No doubt, with the building of better roads, implementation of development plans and the bettering of the standard of living, the demand for bicycles is increasing at a rapid pace, but whether the target estimated by the Government of India at the end of the Second Plan period could be reached is, to say the least, very optimistic.

Due to the critical position in regard to foreign exchange and the consequent lack of import of essential raw materials, two major units, Sen-Raleigh Industries and T. I. Cycles of India are unable to implement their expansion programmes, to produce a larger number of bicycles and components than what they are doing at the present time. These two companies have ordered for additional plant and machinery required to increase their annual output and if the required assistance is given by the Government by enabling them to get enhanced supplies of essential raw materials, they are both capable of and have plans laid for producing substantialty increased number of bicycles and components. There is, no doubt, a huge demand for bicycles and components produced by these well-known manufacturers, as their quality, which is equivalent to that of any foreign brand, has been very much appreciated by the buying public. There is a continuous demand for their components both from smaller manufacturers and the traders for replacement market.

Increasing emphasis is being laid by the Government on the need to develop exports. A target of 75,000 bicycles has been fixed for this purpose in 1958—59 and the Government has also agreed to extend a few facilities to exporters in this direction. It is felt that some headway could be made in exporting of parts and accessories, but it is rather difficult to export complete bicycles. In the first instance, those well-known manufacturers, who have foreign collaboration, have definite territories assigned to them for marketing their products and are not allowed to infringe by exporting to other markets. This was a condition precedent to the establishment of the industry in India and there is much sanctity attached to it and more so now, when the British Bicycle Industry is in a very bad way.

In certain countries in the West, the export prices are much lower, than those produced for local consumption, as there is a subsidy allowed to encouraging exports. Although the Government of India have agreed to refund the duty on raw materials, the encouragement is not sufficient, as prices of the Indian-made bicycles in the foreign markets, even with this concession does not compare favourable with those from other countries. Moreover, the Indian-made cycles do not have the vast range of colour option offered by other foreign manufacturers and this may also be a deterrent to the demand for Indian-made cycles abroad.

Even in spite of the various difficulties, the Indian bicycle industry has forged ahead beyond all expectations. It is one of the few industries which has kept down its prices, in spite of mounting costs of essential materials, rising over-heads and increased labour costs. The protection given by the Tariff Commission and the encouragement received from the Government have, no doubt, contributed towards the development of this essential industry. The dealers and distributors throughout India are doing an excellent selling job as, with the increasing demand for cycles and the inadequate supplies, the margin of profit they derive make this business worth their while. The cycle industry, in short, has come to stay and is growing more and more vigorously and it has taken the pride of place in the development of essential industries in the light engineering section.

* * *

The utilitarian, economic and aesthetic value of good lighting is being increasingly felt all over the country.

LAMP INDUSTRY

KAMALNAYAN BAJAJ

Chairman, Radio Lamp Works Ltd., Bombay

The production figures of General Lighting Service and other similar Lamps in India during the last ten years indicate a rapid increase in demand for Lamps:

Year	*Pieces in Lakhs*	*Year*	*Pieces in Lakhs*
1947	74.14	1953	197.79
1949	136.55	1955	235.37
1951	154.47	1957	320.33

The Planning Commission has estimated that by the end of the Second Five-Year Plan in March 1961 the demand for G.L.S. and other similar Lamps will be about 500 lakhs and for Fluorescent Tubes 20 lakhs pieces per year. The consumption of Lamps in India is at present hardly 1/10th of a lamp per person per year as against about five lamps per person in Western Europe and ten in the United States. With the completion of the many electrification schemes all over the country, the future demand for our products should be very vast.

Progress is linked with good lighting. Better lighting is needed everywhere. The Company has started a Lighting Advisory Service to serve this need.

Hind Lamps Private Ltd., in which the Company has a fifty per cent interest, commenced operations in 1952 as a result of technical collaboration and financial participation with Messrs. N. V. Philips of Holland and four British Electrical Companies. This new venture took over the Company's factory at Shikohabad and has since made a block investment of about Rs. 40 lakhs. Further expansion, for which licences are already received, is estimated to cost over Rs. 50 lakhs. Their negotiations are almost complete for a loan of about Rs. 35 lakhs to enable them to import plant and machinery, and provision is made to meet the balance of Rs. 15 lakhs from their own resources.

The Company will then receive its share of about 10 lakhs of G.L.S. Lamps, 15 lakhs of Miniature Lamps and 3 lakhs of Fluorescent Tubes additionally per annum for sale. The expansion programme should also help in reducing the costs of production.

During the year we have acquired the sole selling agency in India for KASSELS Fans. We have also put in the market chokes and lighting fittings for which manufacturing licence was granted to us last year.

During the last five years, Indian Foundries have felt the need for modernisation. Some recent developments of this industry are excellently portrayed here.

INDIAN CAST IRON FOUNDRIES

B. N. BALIGA, B.Sc. (MET.), A.M.I.E. (INDIA)

Foundry Manager, Cooper Engineering Ltd., Satara

The recent expansion of industries which need quality castings, such as Automobile and Machine Tool, has given the necessary impetus to the Cast Iron foundry industry. The castings required by the above two industries can be classified as quality castings and the production of these in quantities cannot be achieved by slipshod methods.

There are at present over 1,500 foundries spread all over the sub continent of India, out of which about 350 could be classified as medium to large. The production of each of these foundries varies from a few tons per month to 5,000 tons per month.

Many of the medium and large foundries have recently been modernized with the latest equipment and some of the new foundries that have come up recently or are under process of erection, have been planned with such type of equipment from the very beginning.

Electric Furnaces

One of the main difficulties experienced by Indian foundries in producing quality castings is the poor quality of coke obtained in India. It is well known that Indian cokes are very high in Ash content—sometimes as high as 25%. This in turn gives metal of low temperatures and fluidity. In the production of castings for the automobile industry, sections as thin as 5/32" are encountered and metal melted in cupolas with such poor quality coke will not flow into these thin sections. For

machine tool castings where even the smallest defect is not tolerated, this metal will not serve the purpose.

One of the modern methods to provide hotter metal adopted by some foundries, is to duplex the cupola metal in electric furnaces. Metal is first melted in cupolas and the metal tapped at temperatures varying from 1400° C to 1450° C. This metal is transferred into electric furnaces for super-heating and temperatures up to 1550° C are easily available in a very short time.

Duplexing the cupola metal in electric furnaces has an added advantage in that the super-heated metal can be held as long as required at the high temperature.

The most popular among electric furnaces are the low frequency coreless induction furnace and the graphite rod resister furnace.

Another method adopted in improving temperatures of metal melted in the cupola is by the addition of Oxygen to the cupola blast. This method has its limitations. Higher temperatures up to about 35°C are obtained and for castings of medium and heavy sections for general purposes, this would be an advantage. Addition of Oxygen also has increased the melting rate of cupolas normally by 25%. However, comparing the two methods of increasing temperatures, the electric furnace is by far the superior and is finding favour with many Indian foundries, though the initial outlay is necessarily more.

Carbon Dioxide Process

Many Indian foundries have recently adopted the Carbon Dioxide process for the production of moulds and cores to manufacture a large percentage of their castings. The advantages of the process in producing moulds and cores at a faster rate and the elimination of drying in ovens has indeed made it very popular.

The proprietory Sodium Silicate binders have been found to be prohibitive in cost and many foundries have standardized on the commercial grades of Sodium Silicate available with the manufacturers. Sand mixes vary with each foundry. For example, coal dust up to 3% is added to get a better finish and a few foundries add 0.1% cane sugar for improving 'bench life'. The addition of 1% wood flour (dust) added just half a minute before the mill is emptied, gives good cores and definitely improves the knock-out properties. The only disadvantage with this process has been that sand once used cannot be reclaimed.

Typical castings produced by the CO_2 process are Diesel Engine liners, pistons, Pump casings, impellers and castings for textile machinery.

Mechanization

Though India has ample man-power, it has been found that mechanization of certain processes in the foundry is definitely advantageous. There are quite a few continuous casting plants in Industrial centres such as Bombay, Calcutta and Jamshedpur. Mechanization has been applied to cupola charging, core making and sand preparation. In one of the foundries, a sand washing and grading plant of 10 tons per hour capacity has recently been erected. Mechanization has been found to be indispensable for automobile casting as well as castings for textile machinery, sewing machines, etc. Some of the plants have been in operation for a number of years. The continuous casting plants consist of sand preparation plants complete with sand distribution and sand return systems. There is a battery of moulding machines and the moulds produced by these machines are assembled on roller conveyors and then transferred to the casting conveyor which takes the moulds past the casting point and then to the knock-out position. The sand from the knocked out boxes is thrown through the knock out grid on to a conveyor belt under a mangnetic belt to remove particles of iron and through a rotary screen to the main storage hoppers.

Some of the foundries have only mechanical aids such as moulding machines, core blowers, continuous type Vertical Drying Ovens and sand slingers.

Mechanization has also been applied to many of the other operations. Charging of the metal, coke and limestone to cupolas is done either by the skip or by the drop bottom bucket. Some of the equipment is now being manufactured in India.

High Duty Iron—Meehanite

With the expansion of the Machine Tool industry, the demand for High Duty Iron castings has gone up by leaps and bounds. Where strict specifications with regard to Brinell Hardness, Tensile Strength and microstructure have to be complied with, there is no alternative to High Duty Iron. Among High Duty Irons, Meehanite has been widely used for Machine Tools by the well known manufacturers in India.

For very many years Bridge Bearings for the road bridges had been manufactured in steel. During the last few years, these Bridge Bearings are being manufactured in Meehanite. The Tensile Strength specified for the metal in these Bridge Bearings have been used for six bridges in India.

The Bearings have been tested in mechanical laboratories by simulting actual working conditions and they have stood five times the designed load without showing any damage.

S. G. Iron

There are at present three concerns in India licensed by the Mond Nickel Company Ltd., London for the production of S. G. Iron under their patents. The S. G. Iron is manufactured in electric furnaces in preference to cupolas due partly to the high ash content of cokes available and also the fact that sufficiently low phosphoros pig iron is not regularly manufactured in this country. These Indian foundries are capable of producing all types of S. G. Iron castings including those with an acicular and an austenitic structure. At present however, most of the production is either of the pearlitic of ferritic grades.

The production of S. G. Iron, at present, is on a limited scale but is expected to increase in the near future. Typical castings produced are single throw crankshafts for Diesel Engine, trolley wheels and tile press parts and pipe couplings.

"Ductliron"

The Meehanite Metal Corporation in U.S.A. has developed types of Irons which are designated by their Registered Trade Mark "Ductliron". There are four types of Meehanite Metal viz., 'GS' 'GSF' 'GSH' and 'HS'. These irons exhibit graphite in the Nodular or Spherulitic form. The elongation of these types of Meehanite Metal varies from 2 to 20%. These "S" types of Meehanite Metal are being regularly manufactured by many Meehanite Foundries both in U.S.A. and U.K. and experiments for the successful manufacture of these in India have been started in one of the Indian Meehanite Foundries. It would be not long before these types of Meehanite Metal are regularly manufactured by Meehanite Licensees in this country.

Automobile Castings

There are at least two well known foundries in India which successfully handle intricate automobile castings such as Cylinder Blocks, Cylinder Heads, Manifolds, Transmission Cases, etc. In some of the castings for the American cars, very thin sections of 5/32" are encountered. As mentioned earlier, the metal for the thin automobile castings is melted in the cupola and super-heated in an electric furnace.

Some Indian Foundries have specialized in heavy castings. Castings weighing up to 35 tons per piece are made in the usual run of production and the maximum weight of a single casting produced so far is approximetely 60 tons. The new Foundry and Forge plant now being erected would be capable of manufacturing castings weighing 100 tons and above per piece, required for the heavey machinery building project.

* * *

Aluminium pervades the whole range of human activities. Its future lies in the economic future of our country. Shri Ramanan emphasises the versatality of this metal in a masterly way.

ALUMINIUM INDUSTRY

P. G. V. RAMANAN

Indian Aluminium Company Limited, Calcutta

From 1,272 tons in 1953, virgin aluminium production in India rose to 7,771 tons in 1957. While this in itself is statistically a considerable increase, the real expansion of the aluminium industry is yet to come, although part of it is going to take place as early as the beginning of 1959 when India's third smelter will go into production with an initial annual capacity of 10,000 tons of aluminium. This will mean a 133 per cent increase over the present installed capacity of 7,500 tons. Although the Second Five-Year Plan envisages the increase of aluminium production capacity from 7,500 tons at present to 30,000 tons by 1960—61, actual production facilities are expected to reach only 20,000 tons. The present and anticipated production figures are made up as follows :

	Present (long tons)	Anticipated by 1960—61 (long tons)
Aluminium Corporation, Asansol ...	2,500	5,000
Indian Aluminium Company, Alwaye ...	5,000	5,000
Indian Aluminium Company, Hirakud ...	—	10,000
	7,500	20,000

The Hirakud plant is designed for further expansion to 20,000 tons.

The expansion that has already been achieved and is under progress is the logical outcome of India's favourable position as regards mineral resources for aluminium production and the increase in the demand for aluminium created by the growth in industries and the variety in which aluminium semi-manufactures are now available for diverse industrial applications.

India's present estimated total reserves of bauxite (aluminium ore) are 250 million tons, of which 35 million are considered ' metal grade ', i.e. suitable for economic conversion into aluminium metal. With the increased prospecting being carried out by the Geological Survey of India, more deposits of bauxite may be discovered. India is thus very favourably placed as regards bauxite resources, as the present deposits will sustain a sizeable aluminium industry for several generations (about 5 tons of bauxite are required per ton of aluminium in India). In addition to bauxite, adequate electric power at economic rates is the main requirement for aluminium productian (ten units of electricity are required per pound of aluminium). This is expected to be available within the next few years from the hydro-electric projects under completion and yet to be developed.

The abundance of mineral resources for aluminium production and the varied industrial utility of aluminium account for the importance given to the aluminium industry in the National Plans. The Aluminium Committee which Government appointed at the end of 1955 to report on expansion and other issues relating to the development of the aluminium industry, considered that there would be need for setting up of two or more plants each of 10,000 tons capacity, as even with Aluminium Corporation's increase from 2,500 tons 5,000 tons, only 20,000 tons capacity will be available by 1960—61. The Committee had indicated that possibly these two plants may be set up at Salem in Madras and Rihand in Uttar Pradesh. Despite a large number of press reports, many of a speculative nature, there is no definite indication yet as to whether these plants will be set up in the near future. There is a great deal to be said about " balanced regional development ", but sound economic reasoning should not be lost sight of. Large scale production is specially necessary for lowering costs in the primary aluminium industry. Based on the experience of other aluminium producing countries, it may be prudent in the initial stages to set up a single smelter producing 50,000 to 60,000 tons per annum. Moreover the aluminium industry is very capital-intensive. Against about Rs. 1,000 per ton for steel, over Rs. 10,000 per ton are required to set up aluminium production facilities.

According to the Aluminium Committee the demand for aluminium by 1960—61 is expected to increase to between 30,000 and 40,000 tons, while the Tariff Commission had estimated 1958 consumption at 35,000 tons, as follows :—

Application	Tons
A.C.S.R. and all-aluminium cables ...	14,000
Utensils	10,000
Transportation	5,000
Packaging	3,000
Engineering	1,000
Building and Construction ...	1,000
Others	1,000
	35,000

Viewed from the point of view of the known and recognized uses of aluminium in Western countries, the above analysis of consumption reveals a lop-sided development.

Analysis of end uses of aluminium in Canada (1956)

Building and Construction ...	28.5%
Electrical Industry ...	42.4%
Household Supplies ...	5.1%
Transportation ...	11.2%
Canning and Packaging ...	3.0%
Chemical Industry ...	6.6%
Food and Farming ...	1.8%
Other Industries ...	1.4%
	100.0%

The picture in India is however fast changing as a result of the intensive technical development work done by the industry with various end-users of the metal, and even as early as 1958 the analysis in actuality might reveal a more respectable figure for building and construction, to mention just one broad category of end uses. The reason is that, apart from roofing sheets, various extended shapes are now available for the manufacture of door and window frames etc. Similarly the use of aluminium for panelling bus bodies has become an accepted practice with most transport organisations in the country, and the use of aluminium sections for the framework is now under rapid development. The railways are also using more and more aluminium for the panelling of coaches and time is not far when its use for wagon construction is also developed. Packing applications are expanding. Among the miscellaneous uses, the possibility of an aluminium-pigmented primer for steel replacing the traditional red lead and zinc chromate primers, is indicated by the results of certain U.K. tests which have aroused interest in India.

The demand for steel reinforced aluminium cables and all-aluminium cables has been mounting up at fast rate during recent years, as a result of the increasing realisation of the advisability of using these in place of copper cables and the rapid development of hydro-electric and thermal power generation. A spectacular advance in the production of aluminium cables will be achieved with the completion of The Aluminium Industries' aluminium rod and cable factory at Hirakud, towards the end of 1958. When the Hirakud Smelter goes into production it is expected that part of the metal requirements of the conductor industry will be met from indigenous sources. These are now being entirely imported. Current consumption of aluminium in the cables industry is around 15,000 tons per annum.

There is a vast potential for aluminium foil as a packaging medium in India. 1958 is expected to register developments in various fields of foil application, such as gravure printed foil for confectionery wrapping and pharmaceutical packaging, heat sealable foil for strip packaging of tablets, container strip for vial caps and pilfer-proof seals for bottles, label foil for textile, perfumery and toilet products, special foil for the bangle industry, and increased use of milk strip for capping milk bottles. The capacity of Venesta Limited's foil factory in Kamarhati (West Bengal) is being progressively expanded—and by 1960 it is expected that it will be producing 2,000 tons as against 1,400 tons at present.

The above general review shows the varied applications of aluminium in India and the upward trend of consumption in general. It is however just as well to remember that, in spite of all these developments, the consumption of aluminium in this country is very low.

Country		1957 Per capita consumption—lbs.
Australia	...	6.01
Austria	...	10.10
Belgium	...	3.58
Brazil	...	0.88
Canada	...	11.47
Denmark	...	4.84
France	...	9.98
Germany (West)	...	10.84
India	...	0.19
Israel	...	1.77
Italy	...	5.73
Japan	...	2.13
Malaya and Singapore	...	0.67
Mexico	...	0.66
Netherlands	...	3.32
New Zealand	...	3.66
Norway	...	9.83
Spain	...	1.12
Sweden	...	10.07
Switzerland	...	16.10
Union of South Africa	...	1.27
United Kingdom	...	12.88
United States of America	...	23.12
Venezuela	...	3.26

With the increase in industrial activity and in national income that the National Plans will bring about, the consumption of aluminium is however bound to increase in volume and variety, and the already spectacular expansion of the primary industry will be surpassed in coming years by the growth of both smelting and manufacturing plants.

* * *

Here is an exquisite article. It is a masterly analysis. It is high time we wake up to realities of events.

NATURAL SILLIMANITE

W. DOUGLAS

Specially Contributed

Assam's pride must surely be the natural Sillimanite from her Khasi Hills?

True, Assam is one of the centres whose teas command respect in the world's markets. So does, for that matter, the teas from South India. And, we must admit, from Ceylon, from Indonesia.

But only the Khasi Hills in that State of India produces what has been so justifiably described as "the most remarkable refractory yet". Which is praise indeed.

This natural Khasi Sillimanite is being used increasingly by the world's more famous and larger industrial organizations.

Why?

"Very elementary, my dear Watson".

Natural Khasi Sillimanite, even after heating, still contains a high proportion of *genuine Sillimanite.*

No finer tribute to its inestimable value to particular specialised industries, whether in India or abroad, than the report on Sillimanite vouchsafed to us by two eminent German chemists, Messrs. H. Seger and E. Cranger.

From the laboratory examination it may be concluded that the Natural Khasi Sillimanite is a high quality, heatresisting material which may be utilized for the manufacture of heat-resisting building elements for highest stresses.

Let me explain how that eminently sound report came to be made.

Some time ago, through the good offices of Messrs. R. V. Briggs and Co. Private Ltd., (the Calcutta firm of Analytical Consulting and Technical Chemists whose views on such technical matters are respected by both buyers and sellers everywhere), submitted some samples, drawn at random, from a quarryful of natural Khasi Sillimanite, to the noted Laboratory at Goslar (Germany) where the two distinguished Germans hold court. Their report, as quoted in this article, is, as readers will observe, couched in unmistakable language, fortright yet simple.

Before I go further let me tell readers that this natural Khasi Sillimanite plays a vital part in the production of so many major industries—glassware, bulbs, salt, black enamelling, cement, steel, distilleries, sugar refineries, pottery, coal research, to mention a few, off the record, as it were.

These two German authorities are not alone in their commendation of Khasi Sillimanite, " the most remarkable refractory yet ".

Their high opinion of the gift of the Khasi Hills to harassed technicians striving to produce better, more lasting articles, is obviously shared by others equally well placed to express a view that is uncontradictable.

When the Imperial Chemical Industries of Britain sent out a delegation to study and report on the activities of the Indian Glass Industry one of them apparently went out of his way to draw attention to the fact that here indeed was the refractory just as the doctor ordered, to use a trite but pat expression. Of course, he meant the natural Khasi Sillimanite.

This gentleman, a glass technologist, employed by the world's most enterprising organization, for bettering the lot of mankind (from ridding it of Malaria to providing him with Dulux motoring) was rather, in my view, painfully surprised to observe that the natural Khasi Sillimanite is scarcely used in the country where it is available.

IN 5 WAYS
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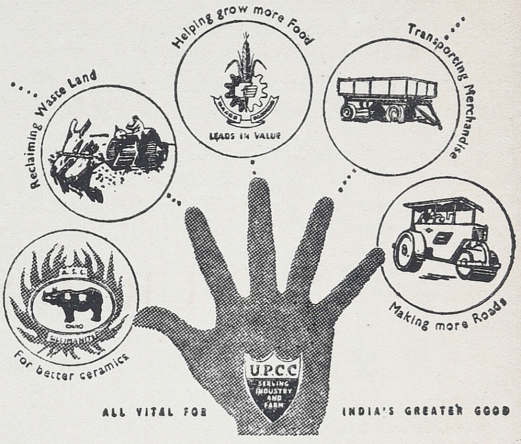

ALL VITAL FOR INDIA'S GREATER GOOD

THE UNITED PROVINCES COMMERCIAL CORPORATION
6, Ganesh Chandra Avenue, Calcutta-13
PPS/UP-108/58

Yet, *mirabile dictu*, thousands and thousands of tons of Sillimanite go to all parts of the globe...to the more knowledgeable of industrialists, who are so successfully competing their respective spheres of business.

In such a circumstance the conclusion is irresistible that our own well meaning and inestimable industrialists have yet to learn the benefits stemming from the use of natural Khasi Sillimanite.

To conclude, let me give a few extracts from a Paper by Mons. Thomas, Director, and Mons. Fourneau, Head of Research Department l' Union Chimique Belge S/A., St. Ghislain, Belgium, read by Mon. Fourneau to the Refractory Products Section, International Ceramic Congress, Florence (Italy) some time ago.

" The name ' Sillimanite ' *is applied erroneously* to a large number of aluminous refractory

products containing 60 to 64% A1203 which are manufactured in fact from the anhydrous aluminous silicate, Kyanite (Disthene).

"*It must be admitted that the use of this incorrect term is somewhat unfortunate and a frequent cause of confusion.* It originates from the fact that when the first refractory products of this type appeared on the market the mineralogical distinction between Sillimanite and mullite had not by then been clearly established. It was believed that heating the products had caused the change of the raw material into Sillimanite.

"Most of the commercial products termed 'Sillimanite' *not only do not contain it all, but have not even been made from this mineral.* This confusion had little importance so long as all the products so termed were manufactured by similar methods, for they all exhibited with minor variations, due to manufacturing details, similar properties and formed a well defined class of refractory materials. This is no longer so.

"Some time ago there appeared on the market refractory products obtained from genuine sillimanite mineral. We prefer to show that these products which we will name, for want of a better term, "natural sillimanite products" exhibit characteristics quite distinct from those of the classic "sillimanite". It may ulimately be convenient to give them a separate place in the classification alongside corrundum products and bauxite products.

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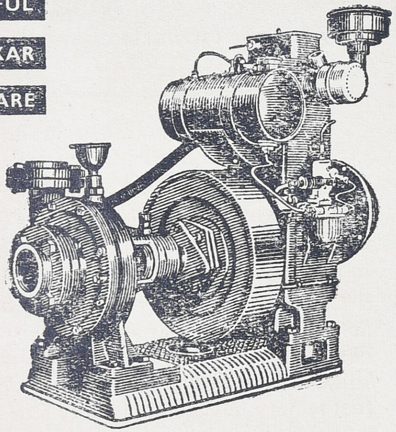

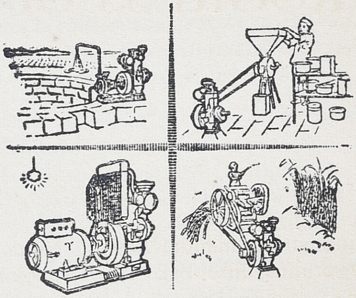

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Indian canners are pioneering under difficult circumstances an industry with great prospects. The finished can is a marvel of precision engineering.

PROGRESS OF METAL PACKAGING

G. ISAAC

Industries manufacturing paints, toilet goods, printing inks, baby-foods, cooking fats, pharmaceuticals and confectionery need a supply of technically sound and attractively decorated containers as a basic necessity for development. The quality and cheapness of their packaging is an important factor in determining the safety of their products, from deterioration and adulteration, the physical extent of their markets, and the volume of their sales. The design and manufacture of containers technically suited to their contents, capable of preventing attempts at adulteration, and at the same time attractively decorated to catch the eye at the point of sale is now a major industry, using expensive machinery and the skills of the sheet metal worker, the chemist, the artist and the printer.

Till recently the four gallon tin, manufactured for the most part in the oil company installations was the only form of metal packaging produced in this country, and nearly all the consumer packaged goods in Indian shops were imported. The pioneer in the development of modern packaging was The Metal Box Company of India Limited, which set up its first factory in Calcutta twenty-four years ago; and now a well developed industry supplies a variety of excellently designed and decorated containers, that compare favourably with metal packaging anywhere else in the world.

The importance of cheap and efficient packaging in this country lies very largely in its ability to prevent the adulteration, and infection is very widespread indeed. In a recent

survey made by the Union Ministry of Food and Agriculture, in which samples of ghee were taken from bulk packs in shops all over the country—it was found that 33 per cent of the samples contained no ghee at all, and a very large proportion of what remained was heavily adulterated.

The establishment of ghee grading stations and the popularisation of the Agmark does not provide significant protection, so long as ghee is packed in four gallon and similar bulk packs, which are easily tampered with. The only real solution is to encourage the marketing, both of ghee and vanaspati in consumer packages: small pilfer-proof tinplate containers which are sealed by the producer and unsealed only in the home when the contents are consumed. The use of small consumer-packages—tamperproof tins is the only way of preventing adulteration and substitution. It is also the precondition of the establishment of the brand habit, both among manufacturers and consumers. The small branded consumer pack, which is being marketed on an increasing scale is the means for the manufactuerer to build up a market on his reputation for integrity and quality; and for the consumer, the means whereby he may encourage the producer who serves him honestly. The hold that the bulk pack continues to exercise over retail markets rise from the cost of tinplate which makes the pilferproof container too expensive for universal use. Indian manufacturers of tinplate containers pay for tinplate supplies a price significantly higher than that paid by manufacturers anywhere else. U. K. fabricators pay approximately Rs. 904 per ton, compared with the Rs. 1,154 for Indian tinplate in Bombay.

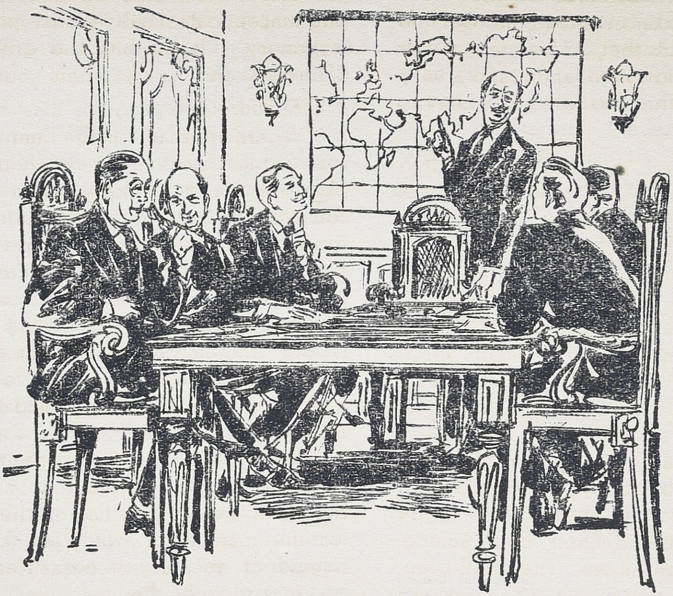
In a country of distances the high freight charges on tinplate and tinplate containers add significantly to their cost, and places this kind of packing outside the means of the manufacturer situated at any distance from the large towns. The high cost of tinplate inhibits the use of the small pilferproof tins and is an element in the price of a wide range of goods which the urban population uses—cooking fats, processed fruits and vegetables, toilet goods, pharmaceuticals, baby-foods, paint and confectionery. It inhibits the growth of these industries and prices them out of possible export markets.

Where tinplate has been available at reasonable prices a major change has taken place in the commodities that enter human consumption, and in the agriculture and industry which produces these goods. Agriculture and the fishing industry in Europe and the U.S.A. send a very large proportion of their production into canneries. This development is not limited to the advanced countries. Prosperous farms are growing up in long backward areas like Kenya, and Malaya whose canned products sell on the world market. Tinplate production has become a large industry—it is estimated that more than half the sheet steel production in the U.K. is used for the manufacture of metal boxes, and a number of ancillary of industries have grown up to produce the machinery, the special printing inks and chemicals that this industry requires. The final result is seen in the new range of goods available for general human consumption in tinplate containers.

An indication of the extent of the canning industry in its present state of development is given below. It is important to remember that this refers only to canned food—and excludes the much larger number of cans used by other industries.

The Canning Industry in 1953—in Millions of Cans and number of Canners

	Offtake of Cans	Canners	Average Offt. ke of Cans
Malaya ...	52	14	37
U.K. ...	2,285	380	60
South Africa ...	370	105	35
Holland ...	350	160	22
Australia ...	1,000	96	104
British West Indies.	38	11	35
Palestine ...	20	30	7
U.S.A. ...	19,200	3,500	55



Twenty-five years ago ...

Nineteen hundred and thirty-three . . . the world is still reeling from the shock of the great economic depression. . . everywhere industrialists are on the defensive, playing safe . . . and yet The Metal Box Company Ltd, London, decide to establish their first overseas company, The Metal Box Company of India Ltd . . . "What foolhardy daring is this?" ask all good and cautious businessmen.

It was foresight and faith that helped Metal Box to take this decision. Foresight that the depression would not last forever . . . faith in the emergence of India from economic torpor into an industrial nation holding out enormous prospects for the packaging industry.

Today twenty-five years later that faith and foresight have been vindicated. Over 5,000 workers are employed in five up-to-date Metal Box factories strategically located in different parts of India. More than 1,000 packers and manufacturers sell over Rs 100 crores of products every year protected by Metal Box cans, tubes, closures and polyethylene bags. The Metal Box Company of India Ltd have earned a place of importance in India's economy.

As India's resurgent economy expands rapidly, an increasingly greater, more complex burden will have to be borne by the packaging industry. As leaders in the field, Metal Box are ready to meet this challenge of the future with all their resources and all their experience.

MB 25 YEARS

The Metal Box Company of India Ltd

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An example of the inhibiting effects of high tinglate prices and high freight rates is seen when the Indian canning industry is compared to the industry abroad. For sometime now, cans of high technical quality have been available to this industry, in small quantities when necessary, and at the lowest prices commensurate with the price of tinplate. The industry has failed by and large to establish itself and progress to date has been disappointing. In 1955 the total offtake was a mere 3 million cans filled by 108 canning establishments, with an average annual offtake of 30,000 cans. Most of these establishments are small and considerable ingenuity is required to adopt modern high speed equipment end technique to meet their small and often unpredictable requirements. The table below gives an indication of the size of the canning industry.

The Canning Industry in India—1953. Number of Cans and Canners

			Number of Canners
Below		4,999	47
5,000	to	9,999	15
10,000	,,	24,999	18
25,000	,,	49,999	10
50,000	,,	99,999	11
1,00,000	,,	149,999	3
1,50,000	,,	249,999	1
2,50,000	,,	599,999	3
Above		600,000	Nil

Indian canners are pioneering under difficult circumstances an industry with very interesting prospects. A very high proportion 15-25 per cent of the annual production of vegetables and fruits goes to waste because of the lack of any preserving facilities. Under the Second Five Year Plan it is understood that there will be a shift in emphasis from cereals to protective foods—milk, meat, fish, fruits, and vegetables. There are certainly very many important opportunities in this situation, but development will depend on the Food Preservation industry's ability to maintain high standards of quality, and to make products that appeal of the tastes of masses. Lower tinplate prices and lower freight rates for both filled and empty containers will be required before a pack is produced which is within the means of the people.

Encouraging progress has been made on the technical side of this industry, in laying foundations which will develop when conditions are more favourable. The technical problems of the packing industry make a fascinating study. The design and decoration of a container within the rigid limitations imposed by costs and materials is a specialised function. Distinctiveness has to be created by decoration where the necessity of rapid production imposes standardization of containers. The 1-gallon rectangular tins, in which a variety of insecticides and lubricants is sold, frequently provide excellent examples of the designer's art. The designer lays the way open, for low costs involved in long manufacturing runs of a standard product, while at the same time providing each customer with completely distinctive containers.

The confectionery and tea trade often require highly decorated and unusually shaped containers, and the artist has to make allowances for extreme disertions of the flat surface on which his drawings will be printed, before the container is fabricated. A very high degree of skill has been achieved, and some of the containers proudly advertised by confectionery and tea firms in the Indian press are fine examples of a specialized branch of the commercial artist's skill. The actual printing of tinplate creates a number of problems concerning printing inks, lacquers and other finishes. A great deal of research has been done abroad, but there are a number of problems peculiar to the Indian conditions. To meet these specific problems, which are created by the quality of Indian tinplate, the Indian climate, and the lack of certain synthetics and other material not locally available, a Research Division has been set up in Calcutta by the Metal Box Company of India Ltd. This service is backed by the extensive research facilities of the company's

British associates, which continues to advise, among other problems on complicated lacquers to prevent chemical interaction between the can and its contents. The problems of preserving Indian fruits and foodstuffs receive attention at the Central Food Technological and Research Institute at Mysore, which publishes a monthly journal recording its activities, and books detailing the processing of a variety of Indian foodstuffs. Recently the Institute has decided to extend the range of its services to industry, by creating a packaging research section.

A crucial consideration in can-making equipment is the necessity of producing cans in very large quantities at very short notice. Foodstuffs for example, are invariably so perishable, that it is not possible to store them. They have to be processed and canned rapidly. This characteristic frequently creates situations in which large quantities of cans are required, at very short notice. The solution is provided by the modern bodymaker and a fine example of modern high speed manufacturing technique. The lithographed sheets of tinplate are slit to very close tolerances and then fed on to the bodymaker, which forms the body and locks the side-seams with remarkable rapidity. A modern bodymaker produces made up cans at a rate of 300 a minute and above.

The formed bodies have one end seamed on, and are supplied in cartons to the customer. Where long range transport is necessary, the body, after it has been formed, and its side seam well soldered, is mechanically flattened, and shipped in this form, with the ends supplied loose. Simple and inexpensive machinery provided, by the can maker, at the filling point, will reform the can, flange, and seam on its ends. The finished can is a marvel of precision engineering. A container manufactured by high speed, capable of being filled and closed with high speed machinery, and of protecting its contents and its appearance, over a protracted shelf life in very trying climatic conditions.

It must be emphasised that all the latest techniques are available here in India, in Calcutta, Bombay, Delhi and Madras. Arrangements between the largest Indian tin box manufacturer and its associates in the US and the UK provides a constant source of the most up-to-date "know how". This refers particularly to the manufacture of tinplate containers, and closures (screw caps and crown corks), but covers in addition packages made from aluminium (rigid and collapsible tubes) and recently polyethylene film.

The tin box manufacturer has acquired an exceptional knowledge of sheet metal fabrication, and of late he has been turning this ability, which he displayed so outstandingly during the World War II, to supplying mechanical industry with a varietly of complicated components including those involving deep stamping. Industries manufacturing motor cars, cycles, electrical equipment, typewriters and duplicators are finding in the specialized "know how" of the tin box manufacturer a solution to many of their production problems. It seems certain that the tin box maker will play a vital role in the industrialization of the country.

* * *

Here is a brilliant account of the Diesel Engine Industry by an eminent specialist. Diesel engines are potential earners of the much needed foreign exchange.

DIESEL ENGINES IN INDUSTRIAL DEVELOPMENT

M. B. DHAVALE
B.Sc., B.Sc. (Eng.) Elec. & Mech., A.M.I.E. (Ind.), A.M.I. Prod. E.
Sales Manager, Kirloskar Oil Engines, Ltd., Poona

Diesel Engines have gained prominence in India during the last decade. These have been in use in our country for quite a long time and were mostly used in small numbers for Flour Mills, Generating Sets, Pumping Sets, Concrete Mixers, etc. World War II created a vacuum for Engines in Indian market. It also clearly exposed our dependability for vital equipments on foreign sources of supply. Quite a few manufacturers then took to manufacture of Diesel Engines. That was the beginning of indigenous Diesel Engine Industry and production of Diesel Engines in an organised manner.

This Industry suffered a brief setback during 1952—54 due to excessive imports of foreign Diesel Engines. Fortunately, Government of India realized the mistake and did not lose time to make amends. Restriction on import of Diesel Engines of 5 to 30 Horse Power was imposed to protect and nourish the young industry. This had the desired effect. Since then, production of indigenous Engines has been increasing from year to year, and the country's needs are being met adequately without need for importing Engines. Consequently, not only valuable foreign exchange has been saved, but also indigenous Diesel Engines now claim to be potential earners of the much needed Foreign Exchange.

Restriction on import of Diesel Engines still continues. This has charged the local industry with certain responsibilities. A probe into the

various development activities vis-a-vis the indigenous Diesel Engines will be interesting as well as informative.

Self-Sufficiency in Food

A Pumping Set for Lift Irrigation is a farmer's best friend. It makes intensive cultivation possible. Two, if not three, crops can be raised in a year thus increasing the yield of foodgrains. Consequently, irrigated farming is one of the most important factors that would help us to achieve Self-sufficiency in Food. Government have realized the important role, Engine Pumping Sets have to play in this connection. All State Governments are now spending large sums for supply of Pumping Sets to farmers against *Taccavi* Lons or under Hire Purchase/Subsidy Schemes. Therefore, most of the indigenous Engines will have been used for pumping water for irrigation.

It has been found that a 5 Horse Power Pumping Set which is the smallest, is too big for the average farmer, as land holding is not large enough. Most wells cannot stand up to the rate at which water is pumped out by this set. Smaller size Pumping sets of 2.5/3.0 Horse power are being manufactured in Bombay State, to meet the farmer's needs and are expected in the market in the near future. This small size Pumping Set would bring forth new demand in our country, which has not been met up to this time.

Estimate of domestic requirements of Engines from 5 to 40 Horse Power till the end of Second Five Year Plan (1961) could be placed at a conservative figure of 60,000 Engines of 5 to 10 Horse Power and 6,000 of 10 to 40 Horse Power. Besides 24,000 Engines of 3 Horse Power will also be needed, if these could be available in the same period.

Mechanisation of Fishery

Fish is the most important subsidiary food in our country, but this God's gift has not claimed the attention it deserves. Fishermen are still pursuing age-old methods to eke out a living. Government have realized that fish can substantially contribute towards achievement of Self-sufficiency in Food. In the Second Five Year Plan, stress has been laid on mechanization of Fishery—business of fishing. Large funds have been allocated for training fishermen in application of scientific methods and use on fishing boats of mechanical equipment including Diesel Engines.

Co-operative Fishing Societies use boats upto 45'/50' length, which are powered by 30 to 40 Horse Power Engines. Mechanized boats with smaller engines are also in use in some fishing localities. Number of mechanized boats is insignificant in comparison with the total number of fishing boats. Technical Experts feel that the most economical boat would be the one having 25'/30' length, powered by a 10 Horse Power Engine. Experiments are being conducted at Mangalore to decide on the exact length and shape of this boat. Its design would then be frozen and copied as standard all over India.

An average fisherman is poorer than the average farmer; a Marine Engine is three times costlier than the land type of equal Horse Power. Those who have closely watched the development of application of Engine Pumping Sets for Lift Irrigation, are of the opinion that Fisherman would need a 3 to 5 Horse Power Marine Engine. It would suit his small rickety boat, as also his meagre purse. Once mechanization of boats catches the imagination of fisherman, it might spread like wild fire. Then manufacturers of Diesel Engines may be kept as busy as ever, trying to meet the demand for 3 to 10 Horse Power Marine Engines for fishing boats.

We are still in the initial stage of mechanization of boats, and it may not be possible to achieve much by the end of the current Plan period. All the same, Fishermen may need about 6,000 Engines between 3 to 10 Horse Power and 4,000 Engines of 10 to 40 Horse Power.

Trawlers for deep-sea fishing and processing the catch on board would need Marine

Engines of much higher Horse Power. It is a matter of great satisfaction that a Factory in Bombay State would soon be taking up manufacture of Marine Engines upto 500 Horse Power, in collaboration with German Principals. Government of India are also considering seriously the establishment of a Factory for the same purpose in private sector and it may be located at or near Visakhapatnam.

Power Supply in Trains

In our country, power supply in trains is 110 Volts D.C. by means of Dynamos driven from axles of carriage wheels. 24-Volt Batteries and special imported equipment are also required. All this equipment is very heavy and very expensive both in initial cost and maintenance. Cost of equipment works out to an average of Rs. 40,000 per K.W. of utilized load and annual maintenance bill runs into a staggering figure of Rs. 1.75 crores. This system also suffers from many other disadvantages. It involves heavy haulage cost. Long halts affect its working efficiency. Under the changed conditions, it is incapable of meeting increased demand for power. Last but not the least, it perpetuates dependance on foreign sources of supply—a vulnerable point in times of emergency.

Increase in power supply in trains is necessitated by the change in policy. Third Class carriages are to be provided with electric fans. In upper classes also, the number of fans have been increased. Number of light points and wattage of each have gone up. All these and Air Conditioned Coaches, Refreshment Cars furnished with Electrical Cooking Equipment and Refrigerators, etc. need much more Electric Power than before.

Experts have suggested change over to "End-on Generation." In this system, Diesel Generating Sets will be installed in the Brake Van of a train for generation of 110 Volt A.C. power supply. Equipment for the purpose will be economical both in cost as well as maintenance. It will also be very light and all of it could be available from indigenous sources.

End-on generation would offer unlimited flexibility in the matter of meeting increased or decreased demand for power supply. Its efficiency will not be affected in any way by halts—long or otherwise. Comparative Economics of one 10 Coach Meter Gauge Train would be revealing.

The Railway Board has ordered a trial of this system on all the seven sections. 15 KW and 10 KW Diesel Generating Sets will be used for Broad Gauge and Meter Gauge trains respectively. If the experiments yield satisfactory results, Indian Railways will gradually change over to End-on Generation. There is on reason why experiments should not produce satisfactory results as American Railways are working this system efficiently. Change over, as and when it comes, will be gradual and it would take quite some time to switch on 1,000 Broad Gauge, 1,000 Meter Gauge and 200 Narrow Gauge Trains to this system of power supply.

Dams, Buildings and Road Construction

Dam, Building and Road Construction industry has received great impetus since the

Power Supplying In Trains	*Existing System*	*End-on Generation System*	*Remarks*
1. Number of Equipment	10	* 2 Sets	* only one will be in use at a time.
2. Number of Batteries (Set of 12 Cells)	20 Sets	Nil	—
3. Weight of Equipment	51,830 lbs.	4,800 lbs.	—
4. Capital Cost	Rs. 2,02,000	* Rs. 66,200	* with modern fluorescent lighting.
5. Annual Maintenance Cost	Rs. 12,600	Rs. 5,300 approx.	—
6. Extension of Power supply	not possible	possible	—
7. Use of modern amenities	not possible	possible	—

introduction of the First Five Year Plan. Housing has become a national problem. Government of India have also set ambitious targets for completion of big dams and large mileage of asphalt/concrete roads. All these activities have naturally created large demand for machinery powered by Diesel Engines. Some of the common machinery used for dam, building and road construction are: Concrete Mixer, Roller Pan Mixer, Asphalt Mixture, Vibrator, Stone Crusher, Road Roller, etc.

The responsibilities of providing the Prime-Mover for all the machinery listed above has now fallen on indigenous Diesel Engine Industry. For this purpose, the Engine requirement will fall within the range of 3 to 40 B.H.P.

All the known manufacturers of Asphalt and Concrete Mixers, Stone Breakers and other machinery have already standardized on indigenous High Speed Diesel Engines as Prime-Mover for their machines.

Road Roller has not received the attention it deserves. Majority of Road Rollers are very heavy and are powered by Engines upto 40 Horse Power. There is a hunch that use of smaller Road Rollers may prove beneficial in the long run. A Roller suitable for 12/14 Horse Power Engine and fitted with sturdy Clutch may prove very useful to a very large number of Gram Panchayats. Very few seem to have the resource to buy a heavy Roller and feed enough work to it. All the items mentioned above would need 2,400 Engines of 3 to 5 Horse Power and 1,200 Engines of 10 to 40 Horse Power during the current Plan period.

Electrification of Small Towns and Villages

Quite a few Hydel Projects are nearing completion and by 1961 or 62 some of them will be in operation. Electricity Boards of States have, therefore, chalked out a plan for installation of Nursery Power Stations in small towns and villages. The idea is to start Power Generation at different centres by using one or two of 20 KW/40 Horse Power Diesel Engine Driven Generating Sets. Introduction of electricity in rural areas may take some time but once the inhabitant gets the taste of these amenities, the Nursery Power Stations will aid development of the electrical load in these areas. Subsequently, this load could be passed on to the Hydel Projects when they come into operation. All that will be necessary is to carry an overhead line from the Hydel Project to the Nursery Power Station. The Diesel Generating Sets could remain as stand-bys or be shifted to other places to work in the same capacity. Authentic figures of requirement are not available.

Defence Services

Equipment used in Defence establishments is now due for replacement. Government have therefore laid down a policy of standardizing on indigenous equipment. Committees appointed by the three Wings of Defence Services are already working on this job. It may also be mentioned here that the Indian Navy would like to switch over to A. C. current during this process. Details of Equipment required and their number are not available. It may be taken for granted that accent will be on equipment suitable for portable applications of Pumping Sets, Generating Sets for Camping Grounds and Mobile Workshops, etc., which will be required in fairly large number. Manufacturers of Diesel Engines will be kept pretty busy meeting requirements of Defence Services.

Miscellaneous Requirements

There are many other development activities needing Diesel Engines. The total requirement would be a sizeable figure, even though each department or application will use a small number of Engines. Civil Aviation, Post and Telegraph and Forest Departments are busy working on standardization of Engine Driven Equipment.

Mechanization of Agriculture is coming slowly but surely. Small Tractors, Tillers, Puddlers, etc., are sure to gain popularity. Some manufacturers are busy experimenting with equipment of Japanese and German make. Later, experiments would be repeated after replacing the imported Engine with an indigen-

ous one. Finally, if experiments are successful, manufacture of mechanical equipment for agriculture would be taken up in right earnest. Engine requirement will be about 6,600 in 3-10 Horse Power range.

From details of various activities described above, contributing to development of our country, the overall demand for Diesel Engines between 1958—61 period works out as follows :—

Requirement Of Diesel Engines During 1958—61
(3 to 40 Horse Power)

	Application	*Number*
1.	Lift Irrigation ...	90,000
2.	Mechanization of Fisheries...	9,000
3.	Power Supply in Trains ...	4,800
4.	Dams, Buildings and Road Construction ...	4,000
5.	Electrification of Small Towns and Villages ...	2,100*
6.	Defence Services ...	3,000*
7.	a) Post and Telegraphs, Civil Aviation, Forest Departments. ...	500*
	b) Mechanization of Agriculture ...	6,600
	Total—	1,20,000

* *Authentic figures are not available.*

Will the Indian Diesel Engine Industry be able to meet this challenge? Answer is emphatically YES, provided favourable conditions could be created to facilitate increase in production.

All metal working Industries are entirely at the mercy of the Iron and Steel Controller. Everyone has to go through an ordeal to get the allotted quota of steel. If conditions could be improved and availability of Pig Iron, Steel Rounds and Sheets made easier, production of Diesel Engines will increase considerably. Total indigenous production in 1957 was 16,543 Engines. In 1958, up-to-date, a 30% increase has already been registered. If manufacturers get the required quantities of raw material, there will be no difficulty in maintaining this rate or even registering increase in production.

At present there is acute shortage of steel. Therefore, efforts should be directed to get maximum power out of available metal. In these days of Jet Planes with supersonic speed, Slow Speed Engines do not fit into the changing times. These Engines use up 80% of the steel available to Engine manufacture, while delivery is only of total number of Engines, as will be seen from following figures.

Comparative Data Showing Weight of Engines Per Horse Power

Weight per Horse Power in Lbs.

Horse Power	6	10	20	30	40
High Speed Engine	65	47.5	45	40	37.5
Slow Speed Engine	170	213	165	227	—

It will be evident that more Engines could be built if the available resources are utilized for building High Speed Engines.

Increase in production of Diesel Engines will also depend on the development of ancillary and auxiliary industries. Oil Seals, Gaskets and Paper Joints, Pistons, Piston Rings, Liners, Valves, Springs, Fuel Injection Equipment are some of the items of specialized nature. Each one by itself could be considered as an independent industry. Capacity of all of these will have to come up to meet the demand. Production of other Equipment and Machinery will also have to increase. Except for Pumps, no other Machinery or Equipment is available in adequate quantities from indigeonous sources.

Taking all these facts into consideration, all will agree that indigenous Diesel Engines are playing a very important role in Development Plans of our country. They will also continue to contribute substantially to the industrial progress of India in the Second and Third Five Year Plans.

The Biggest Thermal electric station in India will be built at Neiveli, Madras State, with the help of the Soviet Union. It will start working before the end of the Second Five Year Plan.

SOVIET ASSISTANCE AT NEIVELI

IGOR KLINGOFF

Soviet Engineer

I recently came back from India with a group of Soviet experts after looking over the place where the electric station is to be built. That will be India's biggest thermal electric station. Its five turbines will develop 250,000 kw., which is considerably more than the capacity of the Bokaro station in Bihar (150,000 kw) or that of the Trombay Station in Bombay (100,000kw).

Besides taking care of the requirements of the new industrial region, the future electric station will make it possible extensively to electrify the villages in the state of Madras. While this State already tops today the list of Indian states for the number of villages supplied with electricity (3,300 out of a total of 7,400 electrified villages throughout the country), the new station will make it possible to electrify another 4,000 in the state by the end of the Second Five Year Plan period.

The project is being prepared by the Thermal Electric Station Designing Institute, where I am working. The institute has designed the biggest thermal electric stations in the USSR, such as those at Cherepets and Shchekino. Our organisation is also known in China and Rumania for whom we have designed a number of stations. We pledged to turn over the complete project for the Neiveli power station by October 14. Indian engineers will also take part in preparing the project and they will come to our institute for the purpose.

Boilers, turbines, transformers and other equipment for the station are being made by well-known Soviet factories which have gained great reputation in building equipment for the big Soviet power stations.

The Neiveli station is to go into operation before the end of the Second Five Year Plan period. It will use the local lignite for fuel.

Already under construction near the village is a small town for the future builders of the power station.

We attended a temple festival in Neiveli at which many people were present and we watched the beautiful ceremonies with interest. We were told that it was a festival in honour of a holy man who, a long time ago, predicted that a large town would be built at Neiveli. We saw in this story evidence of the Madras people's old dream that their region would flourish, and we are happy to give them all the assistance we can in making the dream come ture.

* * *

The Engineering Industry accounts for sixty per cent of the GDR export total. It serves over forty countries. The GDR is the second strongest industrial power in the socialist camp.

THE ENGINEERING INDUSTRY IN GERMAN DEMOCRATIC REPUBLIC

As a supplier of capital goods, and durable as well as short-life consumer goods, the engineering industry occupies a key position in the national economy of the German Democratic Republic.

Under the conditions of socialism its systematic development is given priority, in accordance with its important role in expanding socialist reproduction. As a source of the major means of production it exerts a decisive influence on the planned advance of our economy and on the fast growth of labour productivity. It is precisely this question which is receiving the most earnest attention in our state of workers and peasants, in the knowledge that in the final analysis only a fast growing labour productivity ensures the victory of socialism over the capitalist system of economy. This is also the pattern of development set for the engineering industry within the framework of the Second Five-Year Plan. It states that the GDR machine building industry by 1960 will reach a level 52 percent above that of 1955. This includes the supply on a large scale of the latest types of high performance machines and plant for equipping of the home industries, e.g. for the mining and power industries, for the chemical and light industries and items needed for the socialist transformation of agriculture.

The GDR possesses a highly developed industry, with a long history behind it. As regards out-put she holds fifth place in Europe today. A large share of this falls to the credit of the machine building industry which had attained to a high level already under capitalism and which now forges ahead unfettered and systematically under the conditions obtaining in the first workers' and peasants' state in German history. The outstanding skill and experience of the metal-workers of the GDR, combined with the unstinted aid rendered by the other socialist countries in the building of our state, have contributed greatly to the growing prestige of the GDR engineering industry at home and abroad in recent years.

However, the role of the engineering industry is not limited to that of a supplier of capital goods designed to strengthen our own economy. It also plays an important part in helping to advance the national economies of the other socialist states. The fact that the GDR is the second strongest industrial power in the socialist camp imposes special obligations on our engineering industry. It helps the other socialist states in the development of their own industrial basis through the delivery of machines and equipment while taking full advantage of the aid offered in return.

This specifically socialist principle of mutual assistance finds its expression in the co-ordination of the respective national economic plans, in the beginning industrial specialisation on an international scale and in steadily growing system of inter-state co-operation. These measures prepare the ground for the ultimate changeover to mass production methods on a large scale and a corresponding reduction in costs per unit of out-put. The need to achieve a high economic result from a minimum of material is dictated by the limited raw material resources of the GDR engineering industry, a factor which will increasingly mould its future character and consequently also affect the pattern of its export commodities. This is not, however, an emergency measure, but the logical course for the industry to take under the economic conditions prevailing, in a country which disposes of a highly developed machine building industry, yet is to a large extent dependent on imports. This is the background against which the priority development of this branch of the engineering industry with a high proportion of refining processes must be seen.

Not a few products of the engineering industry of the GDR are today ahead of the international level of competing in the industries in other countries, which explains the steady increase in the export of engineering equipment and factory plant. The engineeing industry accounts at present for 60 per cent of the GDR export total. Its list of customers comprises more than forty different countries. In the course of the Second Five Year Plan the industry will make available 8 per cent more goods for sale in foreign markets. The biggest share of this is to be borne by those branches of the industry with a high proportion of labour costs, which are to increase their exports this year by roughly 30 per cent on the 1956 figures. This refers to such branches as appratus construction, textile machinery, installations for the printing and allied industries, machines for food processing and packaging, precision engineering and optical instruments. Among the leading firms in this field are found such enterprises as VEB Carl Zeiss Jena; VEB Plamag, Plauen; VEB Optima, Leipzig; VEB Victoria, Heidenau; VEB Transformatoren—und Rontgenwerk, Dresden, with medical and X-ray equipment; VEB Tabakuni; VEB Schokopack, beside a number of machine tool manufacturing concerns, famous the world over for the high technical standard of their products which found an appreciative expert public at the 1958 Leipzig Spring Fair.

The fact that all export earnings are used to pay for essential imports of raw materials and consumer goods opens favourable possibilities for countries intending to trade with the GDR on the basis of equality and mutual benefit. Moreover, such trade constitutes a sound foundation for the establishment of friendly relations among all nations.

The trade with the socialist states, carried on under conditions of equality, mutual respect and selfless assistance, is a manifestation of the principle of international socialist solidarity. It creates extremely favourable conditions for the future development of our engineering industry, which find their expression in the conclusion of long-term trade pacts between the GDR and the other countries of the socialist camp.

The export of engineering products to countries of the capitalist world market has seen a continual expansion in recent years. Apart from cultivating their traditional commercial relations in this field, the socialist firms of the GDR engineering industry have broken fresh ground and established new links, in particular with the rising national states in the Middle and Far East and in Africa. A similar trend can be observed in trade with the German Federal Republic.

As in the past, the working people and the technical and scientific personnel of the GDR engineering industry will continue to play a decisive part in helping to raise the living standards of our people and to give convincing proof of the peaceful intentions of the German Democratic Republic.

* * *

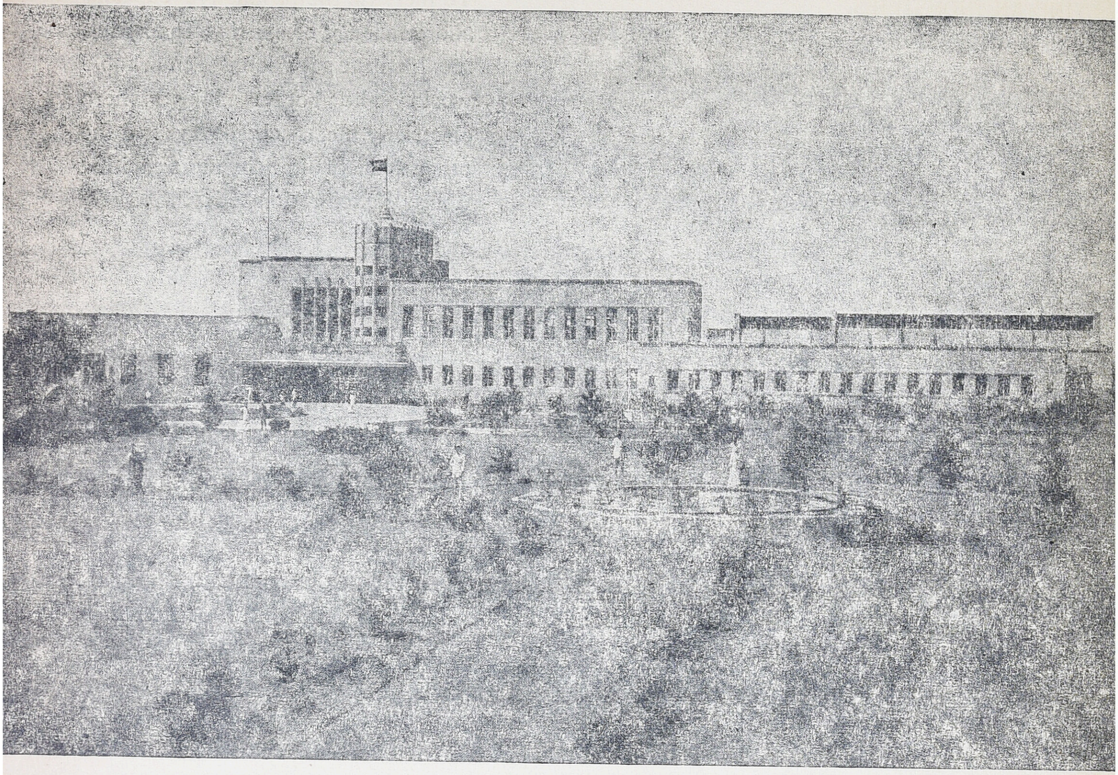
Sindri's Role in
India's Expanding Economy
THE SINDRI FERTILIZER FACTORY, which is the first major industrial project of the Government of India to be completed after the attainment of independence and the largest fertilizer factory of its kind in Asia, has led the way by increasing the country's production of fertilizer and thus contributing materially to increased food production.
THESE FACTS ARE SIGNIFICANT
Sindri's total production of fertilizer (ammonium sulphate) has so far been over 13.8 lakh tons, equivalent to a saving of over Rs. 48 crores in foreign exchange.
In terms of food production it means over 27 lakh tons more food, valued at over Rs. 78 crores.
Sindri is thus helping the farmer, the backbone of the country, to retrieve his stature and gain new strength, thereby putting India's economy on a solid foundation.
Sindri Fertilizers & Chemicals (Private) Ltd.
MINISTRY OF PRODUCTION,
GOVERNMENT OF INDIA.

To increase the productive capacity and efficiency of existing Industries, the Institute is doing remarkable work. The border lines where electricity meets chemistry and the other sciences offer the most exciting fields of exploration today.

CENTRAL ELECTROCHEMICAL RESEARCH INSTITUTE

The Central Electrochemical Research Institute, Karaikudi is one of the National Laboratories established by the Council of Scientific and Industrial Research with the twin purpose of promoting scientific endeavour in the country and aiding in the industrial and technological development of the country. The Council had recognised the need for a separate institute for electrochemical research from the very beginning in view of the rapid developments taking place in the generation of hydro-electric power on a countrywide basis and at localities within easy reach of the raw materials needed for the chemical industry. The proposal for an electrochemical research institute took concrete shape when the late Dr. Rm. Alagappa Chettiar came forward with a donation of 15 lakhs of rupees and 300 acres of land to the Council for founding the Institute. Initial difficulties in ensuring an adequate water supply were soon overcome and Institute was formally declared open by the Vice-President of India, Dr. S. Radhakrishnan on the 14th January, 1953.

Electrochemistry is pre-eminently a borderline subject and electrochemical research is alive with great potentialities which may change the very face of industries by unfolding novel techniques, improved methods and new materials. Research of an applied nature with a view to increasing the productive capacity and efficiency of the existing industries for utilisation of Indian raw materials will be the



Electricity enters into the production of a large variety of basic materials-metals, alloys, pure chemicals, fertilisers, abrasives etc., many of which serve again for other industries. It is indispensable in the production of aluminium, magnesium, sodium, calcium carbide, graphite, fused alumina etc. It leads to a purer product as in the production of metals like copper, tin, lead, nickel, gold and many of the special alloys and steels.

Electro-chemical industries cover today almost every field of national endeavour in India and the Central Electro-Chemical Research Institute at Karaikudi is doing excellent work.

main function of the Institute. Basic or fundamental research which only can open out new fields of knowledge leading to valuable discoveries of far-reaching and practical significance is within the scope of this Institute. Besides fostering basic research and conducting investigations of an applied nature the other functions of this Institute include setting up of pilot plants to prove the commercial feasibility of laboratory scale researches, maintenance of liaison with workers in allied fields of research and with industries, evaluation and standardisation of raw materials and finished products and collection and dissemination of technical information and data pertaining to industries.

To largely achieve the objectives and fulfil the functions indicated above, the work of the Institute is organised under the following five Divisions:

I. Electrothermal products and Fused Salt electrolysis.

II. Electrolytic Cells.

III. Electrodeposition and Allied Processes.

IV. Theoretical Electrochemistry.

V. Research Utilisation and Information.

The Institute started active research soon after its opening, when Dr. B. B. Dey joined as its first Director. The research programme was formulated in relation to the needs of the existing electrochemical industries in the country and new ones which were expected to come up as a result of the development programmes of the First Five Year Plan, emphasis being placed on applied research of direct utility to the industry.

Among the problems taken up for investigation early in 1953, special mention may be made of the utilisation of Neiveli lignite for the electric furnace production of calcium carbide, the production of electrolytic manganese from low grade Indian ores, the electrolytic recovery of pure lead and antimony from battery wastes, development of processes for the electrolytic production of technically important inorganic and organic compounds, particularly for use in antifouling paints for ships' bottoms, battery grade manganese dioxide from low grade ores, caustic soda and sulphuric acid from sodium sulphate for direct re-use in the viscose rayon industry, ammonium persulphate and hydrogen peroxide, aminophenols for use as dye intermediates and photograghic developers, salicylaldehyde, hard chromium plating of bearing surfaces, anodization of aluminium for different decorative and other purposes, and fabrication of new types of primary wet cells out of cheap indigenous materials in order to replace costly imported varieties of cells.

Research projects of importance which were taken up in subsequent years include studies on the production of improved types of lead-acid batteries, the electrowinning of zinc from Zawar ore concentrates, electrodeposition of cobalt-tungsten alloys from aqueous solution, alloy gold plating, hard chromium plating of different types of engineering parts, including injector delivery ram cones, textile machinery parts, calandria tubes of sugar evaporators, machine tools etc., the production of nickel-cadmium accumulators, polarographic analysis of impurities in metals, the production of hydrazine by electric discharge methods and the electrolytic preparation of perchlorates, hydrosulphite, basic aluminium salts for use as special tanning agents, etc. Side by side with these, ad hoc problems suggested by the industry, such as the purification of zinc chloride liquor by electrochemical oxidation of the iron impurity, the malleabilization of cast-iron, stop-off materials for use in gold-plating etc., were also investigated.

One of the important contributions of the Institute has been the development of the rotating electrode technique in preparative electrochemistry. The use of the rotating electrode has been found advantageous in such diverse processes as the production of cuprous oxide, calcium gluconate, p-aminophenol, and salicylaldehyde. The application of this

technique enables the use of much higher current densities than is possible at stationary electrodes and correspondingly increases the production capacity of a cell of given size. Another important advantage of the technique is that the electrode reaction can be kept under much better control, and the conditions readily adjusted to obtain any one of a number of possible products. Fundamental studies on the kinetics of reactions at rotating electrodes have also been carried out and have yielded interesting information on the changes in reaction mechanism brought about by rotation of the electrode.

The Institute has completed the work on a number of problems mentioned above, and several other processes have been brought to a stage when they could be handed over to industry on the basis of further pilot plant trial. The processes developed for the production of cuprous oxide, calcium gluconate, p-aminophenol and diaminophenol, salicylaldehyde, perchlorate and the production of basic aluminium salts, anodizing, dyeing, multi-colouring, printing and photographic reproductions on aluminium, the new primary wet cell evolved as a cheaper substitute for Leclanche type sac, dry and inert cells, are all ready for industrial utilization and necessary action is being taken towards their commercial development. The processes developed for the electrolysis of sodium sulphate for obtaining rayon-grade caustic soda and sulphuric acid, the electrolytic recovery of lead and antimony from battery wastes, the production of electrolytic manganese using the chloride bath, and the preparation of battery grade manganese dioxide from low grade ores have been successfully tested in large laboratory scale operation and would be released to the industry after larger scale trials to study the economic aspects.

The research programme of the Institute has recently been reviewed in the light of the development schemes included in the Second Five Year Plan, the following being some of the important projects which have been taken up in 1956—57 :—

1. Electrolytic oxidation of toluene to benzaldehyde
2. Electrochemical production of lead from Zawar ore concentrates
3. Preparation of cupric hydroxide and copper powder for use in anti-fouling paints
4 Development of improved types of dry cells
5. Electrochemical studies on protection conferred by different metal finishing treatments
6. Corrosion of metals and metallic couples under tropical conditions
7. Preparation of lead peroxide electrodes for use in place of platinum
8. Kinetics of electrode processes :
   (*i*) Anodic behaviour of metals
   (*ii*) Reactions at rotating electrodes
   (*iii*) Studies on the redoxo-kinetic effect
   (*iv*) A. C. Polarography

Professor K. S. G. Doss took over charge of the Institute on the retirement or Dr. B. B. Dey in January, 1957. The scientific staff now consists of 54 workers, with Dr. A. Jogarao and Dr. H. V. K. Udupa as Assistant Directors, 3 Senior Scinetific Officers and 7 Junior Scientific Officers. Over 70 papers have been published on the work carried out in the Institute so far, and 23 patents have been taken or applied for.

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* *

Small Scale Industries will benefit tremendously by adopting these new techniques.

NEW TECHNIQUES IN ELECTROPLATING

Electroplating of articles is mainly undertaken to protect the base metal from rust and corrosion and thereby enhance the durability of the articles, and for decorative purposes, in which the article is finished in such a way that the final finish catches the eye of the customer, and thereby induces sales.

Efforts have been made by the Small Industries Service Institute, New Delhi to develop the industry by introducing scientific methods of plating through demonstrations, actual production trials, and training of the workers engaged in plating and creating awareness in the Industry of the necessity of technical control of the process and plating to required specifications to produce good quality products. Some processes and types of plating baths which were not in vogue in India were introduced recently by the Institute. This has led to an improvement in the quality of the products of the small scale units that have adopted these techniques.

Tin Plating

Tinning of brass articles has been done for centuries by what is known as *Pucca Qalai* industry. The practice has been to heat the articles on an open fire after which they are tinned with an alloy of lead and tin.

As a result of a number of experiments at the Major Institute at Ludhiana and in the Regional Institute's Laboratory at Okhla, a new technique for tinning has been standardized.

The plating is done in a solution made of 2 lbs. of sodium stannate, 1 oz. of caustic soda and 4 oz. of sodium acetate per gallon of water at a current density of about 10—15 amp/sq. ft. for 4—5 minutes. The article after plating, is taken out, dipped in dilute hydrochloric acid for a few seconds and then again dipped in cylinder oil maintained at a temperature of about 300° C for 1-2 minutes. To the oil, 1/8 oz. of oleic acid is added per gallon of oil. This dip melts the tin in situ and makes it flow into the article. The article is now taken out and cleaned in kerosene to remove the heavy oil, dried and polished very lightly if necessary. Successful results have been obtained according to this method both in quality as well as in quantity.

This process has two advantages over the old conventional method, namely, (*i*) it is free from lead which is poisonous to the human system when in contact with acidic food-stuffs, and (*ii*) the coating is much more uniform.

A number of Units at Moradabad, Jagadhari, Rewari and other places are introducing this technique at the instance of the Institute.

Immersion Tinning

A new experiment has similarly been tried in the press button industry which is new to

India. The individual article is very small, delicate and difficult to be handled independently. It is a job to give these articles a finish which is white, bright and still cheap. After a number of trials in the Laboratories of the Institute, a satisfactory plating technique has been evolved.

The brass buttons are degreased in a barrel for about 3-4 hours using sodium cyanide (1 lb.) caustic soda (1-2 oz.) wetting agent (1/8 oz.) mixture per gallon of water. They are then washed, and bright dipped in sulphuric acid (6 parts) Nitric acid (1 part) Hydrochloric acid (a very small quantity) water (6½ parts) mixture for about 15—30 seconds. They are then washed in water and the last traces of the acids are removed in tartaric acid solution (4 oz/gallon of water). This is followed by washing in water and tinning in a solution made up of 0.7 oz. stannous chloride, 8 oz. thiourea, and 1 oz. hydro-chloric acid per gallon of water for 30—45 seconds by simple immersion. Now they are taken out and washed and dried.

The process is quite simple and with a little training, a worker can easily handle the production.

Nickel Plating by Barrel

Barrel nickel plating of small articles is another experiment tried by the Institute. There were a few parties who were doing this work but the finish obtained by them was either semi-bright or dull and required further manual polishing, which defeated the very purpose of barrel plating. Bright barrel nickel plating has now been successfully introduced by the Institute in many plating shops.

The process consists of polishing the article with leather cuttings or emery flour-oil paste in a closed barrel for 6—8 hours. The articles are then taken and degreased in a barrel for 3—4 hours, using 10% caustic soda solution containing little wetting agent as the medium. They are then washed in water, dipped in dilute acid, washed again in water and taken to the nickel barrel. The nickel solution is made up from Nickel sulphate, Nickel chloride and Boric acid as per watt's formula and 1-2 oz. of brightner for 1 gallon of solution. The density of the solution is maintained at 20 Be/ and pH between 5.0 to 5.54 The plating is carried for 3 hours at a voltage of about 10—12. The articles, which are bright, are then taken out, washed and dried.

The brightner is consumed in the plating and is necessary to replace the same by fresh additions after every two batches at the rate of 1/8 oz/gallon of solution.

The process is easy to operate and very simple to control.

De-Brassing

Generally, when a metal joint is brazed with an open flame there is some excess metal deposited at the joint. This is usually removed by filing or grinding, which is tedious, cumbersome and costly. A process very simple to operate with new and cheap electrolytic bath using indigenous materials has been evolved by the Institute.

Debrassing is done by making the article the anode in a solution made of 1 lb. of Potassium nitrite and 1/8 oz. of nitric acid per gallon of water with a potential difference of 6 volts across the leads for 5—10 minutes when the excess brass at the joint is dissolved. Now the article is taken out and cleaned and further processing done.

Composite Plating

Practically none of the units in the small scale sector have been able to produce a finish which could be guaranteed against rust for a specific length of time. The Institute is trying a process, especially for cycle handles, in which the article is given a pre-coat of cadmium before the usual copper nickel, chrome deposit. The cadmium deposit ensures good rust-preventive properties and the finish can be guaranteed for a specific period. The process is being introduced on experimental lines in in the plating shop of a small unit producing cycle handles.

Gigantic is the growth of Russia's industries. With awe and admiration the world watches its magnificent successes.

METALLURGY

A. MERKULOV

Engineer, U. S. S. R.

No branch of national economy could do without metal. It is the increase in the output of cast-iron, steel and rolled goods that marks the consolidation of a country's might and independence, the rise of its people's prosperity.

Before us there lies an Industrial Reference Book published in 1918 in Petrograd. It comprises data on the development of industry in pre-revolutionary Russia.

Here is what we read on the first page: "...Being the largest country in the world in territory and the third largest population, Russia was holding the fifth place in the world and the fourth in Europe regarding the total volume of its industrial output. A half of its demand in machinery was covered by importing it from abroad..."

There is the following reference on the development of metallurgy:

"...Pre-revolutionary Russia's place as regards the per capita production of metal was one of the last in Europe. Nearly three-quarters of all metallurgical enterprises were concentrated in the south of the country—in the Donets Basin, the Dnieper area, the Azov Sea area. Most of the plants were the property of foreign firms..."

After the October Revolution the nationalized metallurgical industry was faced with the task of providing the country with metal.

In 1928 the Soviet Union proceeded to realize its five-year plans for the development of the national economy. 1500 major state-owned industrial enterprises were put into operation in the first five-year-plan period (1928 to 1932). The first sections of such metallurgical giants as the Magnitogorsk, Kuznetsk and Kerch Iron and Steel Works, as well as the Cheliabinsk Ferro-Alloy Plant started functioning. The metallurgical plants in the Urals and in the South of the country were subjected to fundamental reconstruction.

As a result of fulfilling the assignments of the first five-year plan, the Soviet Union advanced to the second place in the world and the first place in Europe in the production of cast-iron and steel.

In the following five-year-plan periods the Soviet Union scored still greater successes in the development of its iron and steel industry. This is borne out by the fact that in 1957 the USSR produced 37 million tons of cast-iron (more than Britain and France put together), 51 million tons of steel (more then Britain and Western Germany put together). It should be borne in mind that in 1913 Russia's cast iron

output was two and a half times less than Britain's.

However, the development of the USSR's metallurgy was effected not only by building new enterprises. It was only due to the reconstruction of old plants, due to the improvement in the technology of cast-iron and steel production.

Considerable changes have also taken place in the distribution of metallurgical enterprises throughout the country. While in tsarist Russia they were concentrated in two or three districts of the country alone, now they are located throughout the whole territory of the Soviet Union. Such areas as Central Asia, the Caucasus and Western Siberia now have metal of their own. A new, the third, metallurgical base is now successfully being developed in the East of the country.

The development of the iron and steel industry has served as the decisive factor in the growth of machine-building—the foundation for the technical progress in all branches of the national economy. The years of the first five-year-plan periods saw the construction of the Urals and the Kramatorsk Heavy Machine-Building Plants, of the Moscow and Gorky Automobile Plants, of the Stalingrad, Cheliabinsk, and Kharkow Taactor Plants, and of many other enterprises.

Many industries had been founded anew, among them the automobile, tractor, aircraft, ballbearing, machine-tool and a number of other industries.

The development of iron-and-steel metallurgy played an important role in the growth of the country's electrification, in the utilization of water resources, in the development of the railway and water transport, and in that of power-machanical engineering. The Soviet Union now produces the biggest-in-the-world turbines, generators, dynamoes, hydraulic pumps and unique equipment for hydro-power stations, canals and irrigation systems. The USSR's railway transport is being equipped with powerful oil-, electric-, and turbolocomotives. Soviet-made motorships and diesel-electric vessels are cruising in the waterways of the country. The first atom-powered icebreaker in the world has already been launched.

In tsarist Russia's agriculture the share of mechanical engines in agricultural production amounted to less than one per cent, whereas in 1957 there were 1700 thousand tractors (in 15 h.p. units), over 450 thousand grain harvester combines, approximately 660 thousand lorries, and millions of other agricultural machines.

The powerful development of metallurgy and machine-building paved the way for further growth of the coal, oil, gas and all other branches of industry.

At present the coal industry is equipped with all types of coal mining combines, heading machines, and other mechanical implements. Turbo-drills, electric drills and other Soviet-made machinery are widely used in the oil and gas industry.

The light and food industries are undergoing technical re-equipment. They are being provided with first-rate highly efficient machinery. Continuous production lines and high-efficiency continuous technological flow sheets are being introduced at enterprises that manufacture consumer's goods.

On the basis of a highly developed heavy industry, such important industrial branches as radio engineering, instrument-making, machine-and equipment building for the atomic industry, the production of unique forgepress equipment, high-speed electronic computers, instruments for contactless control of radio active isotope application, and many other branches have been created in the USSR within the past fifteen—twenty years

The construction in the USSR of high-speed jet and turbo-prop passgenger air liners, such as the "TU—104", "TU—114", "IL—18", etc., the building of super-long-range intercontinental ballistic guided missiles, and the launching of heavy man-made Earth satellites could also not have been possible but for a highly developed metallurgical industry.

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